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OF

HUMAN ANATOMY,

GENERAL, SPECIAL, AND TOPOGRAPHICAL.

TRANSLATED FROM THE ORIGINAL GERMAN

OF

DR. ALFRED VON BEHR,

AND ADAPTED TO THE USE OF THE ENGLISH STUDENT,

BY
NEW YORK
JOHN BIRKETT,

FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, AND
DEMONSTRATOR OF ANATOMY AT GUY'S HOSPITAL

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TO

STUDENTS OF ANATOMY,

THE FOLLOWING PAGES ARE INSCRIBED

BY

THE TRANSLATOR.

London, October, 1846.

M369931

THE AUTHOR'S PREFACE.

THE "Pocket-book of Anatomy" is intended to afford the Student a short and comprehensive detail of anatomical facts, suited to the practical tendency of the "Medical Encyclopædia."* It may serve either as an introduction to the study of Anatomy, or for refreshing the memory, more especially of those preparing for examinations. With this view, the relations which Anatomy bears to Physiology, Pathology, and Surgery, have been considered in an especial manner, either tacitly intimated, or expressly mentioned; but critical and useless observations have been, as far as appeared practicable, disregarded.

Our German Handbooks and introductions (especially that of C. A. Bock) have only very lately attempted to appropriate, from the French, the advantages of a clear, summary, and agreeable detail; the author of the Pocket-book also thinks that he might take the latter as a model for his work without derogating from the much-prized German profoundness. We trust we shall not be misunderstood, as though we were going to encourage an unscientific superficiality. On the contrary, we wish that the science were seriously considered, and that the trouble which the mere elements require, increasing, as it does daily, with the growth of materials, may not be unnecessarily enhanced, but applied to that which is really useful.

The science of Physiology and Anatomy has, since the year 1838, received so important an elevation in consequence of Schwann's cell theory, that the author does not hesitate to take it as the foundation of his work, and he chiefly refers for farther study to the admirable work of Henle (Sömmerring, *Allgemeine Anatomie*, ed. Henle).

In the special anatomy, the author, although aiming at the greatest brevity, saw the necessity of frequent repetitions, which, although of use to the Student, are detrimental to the uniformity of the book; which, by the utmost precision in doubtful points, by greater amplitude in some sections, by the statement of numerical determinations, by tabular views, and by the addition of the Topographical portion and the *situs viscerum*, he tried to give it, and thus to make it preferred to similar pocket-books.

* See Translator's Preface.

TRANSLATOR'S PREFACE.

THE following pages have been translated from one of a series of volumes, entitled "The Pocket Encyclopædia of the Medical Sciences," by Dr. von Behr and Dr. Minding, and now in course of publication at Erlangen.

The translator has long experienced, in his daily intercourse with students, the disadvantages under which they labour from the want of a really elementary work on Anatomy,—one which would, by giving a well-defined outline of the subject, lead them to fill up the picture from the book of Nature, or more elaborate and highly finished works. Of such books the Student has, now, as many as he can desire, but their size, beauty, or prolixity, render them better adapted for reference than as class books for their course of study. This translation was, therefore, undertaken in the hope that it might lead to an assiduous and earnest study of the *subject* in the dissecting-room, and not with the view of superseding the diligent prosecution of the inquiry by means of dissections,—the *only* mode in which an accurate and *available* acquaintance with the structure and *arrangement* of the organs of the body can be acquired.

To assist the Student, however, in the literature of the science, references have been made at the head of each division of the work, to such monographs in the English language as contain original observations.

The translator has made additions in a few places, which are thus indicated [·]; and in the Topographical portion he has given such instructions as he considers most suitable for the display, by dissection, of the parts described.

The abbreviations in the body of the work were adopted as consistent with the intention of the book; namely, to embrace as great a number of facts in as small a space as possible.

The marks ' , " , ' ' ' , express, successively—a foot,—an inch,—a line.

The translator does not concur in all the observations made by the author.

Should this translation be found useful to the Student, other volumes of the series will, perhaps, be published.

London, October 1846.

ANATOMY.

"Along with the observation of the living person, the more searching examination which could be carried on in the dead body, and the comparison of various kinds of animals, soon showed that this pursuit was rich in *knowledge* and *interest*. Moreover, besides the interest which the mere speculative faculty gave to this study, the *art of healing* added to it a great practical value, and the effects of diseases and of medicines supplied new materials and new motives for the reasonings of the philosopher."—WHEWELL. *Hist. of the Inductive Sciences*.

"The most simple mode of investigating an animal body is first to consider the matter of which it is composed."—HUNTER.

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HANDBOOK

OF

HUMAN ANATOMY.

1. ANATOMY (*ἀνατίμνειν*, to dissect) has for its object a knowledge of the separate parts of organic bodies. Every organism consists of a series of different parts (organs) associated together with a view to the maintenance and self-preservation of the whole, which, likewise, proceed from the connection of dissimilar structures (tissues). The consideration of the tissues, their form, development, and constituents, belongs to the general part of anatomy ("Anatomy of Tissues," *Histologia*), a science, for the foundation of which we have to thank Bichat (born 1771, died 1802), and for the farther advance of which we are indebted to the labours of more modern inquirers. A description of the organs forms the particular part, Special Anatomy.

GENERAL ANATOMY.

2. The animal body consists of solid and fluid substances, which, permeating one another, may, by chemical means, be resolved into proximate and ultimate elements, and supply the material base to the forms of the elementary constituents and tissues.

I. CONSTITUENTS OF THE HUMAN BODY.

3. The 17—19 bases which the chemist recognises in the tissues and fluids of the healthy human body, are:—

Oxygen, Hydrogen, Carbon, Nitrogen; Phosphorus, Sulphur, Chlorine, Fluorine; Potassium, Sodium; Calcium, Magnesium, Silicium, Aluminum; Iron, Manganese, Titanium, and (according to Raspail) Arsenic, Copper.

Of these Oxygen, Hydrogen, Carbon, and Nitrogen form the principal mass of the fluids and soft tissues; Lime (as phosphate and carbonate of lime) that of the bones; the rest are found in smaller quantities only. A few of

them are present in a pure state (Nitrogen and Oxygen in the blood, Nitrogen in the intestinal gases), the rest in binary, ternary, and quarternary compounds.

4. Binary, called inorganic compounds:—

1. *Water*; composes the largest part of all animal fluids, permeates most solid parts, giving rise to their various degrees of softness.

2. *Carbonic Acid*; in blood, urine, the exhalations from the lungs, and the cutaneous transpiration; in their salts.

a. Carbonates; of Potassa in Serum.

b. — Soda, in Serum, Hæmatin, Bile, *liq. Amnios*, Mucus, Sweat, Saliva, Tears; Cartilage, Bone, Teeth.

c. — Ammonia, in Urine and *liq. Amnios*.

d. — Lime, in Cartilage, Bones, Teeth, Sand of ear, Nails.

e. — Magnesia in grease of the skin.

3. Phosphatic Salts:—

a. — Soda in Serum, Hæmatin, Bile, *liq. Amnios*, Urine, Sweat, Saliva, Tears; Nails, Cartilage, Muscles.

b. — Lime in Bones, Cartilages, Teeth, sand of Pineal gland.

c. — Soda and Ammonia in Urine; Blood (Hünefeld).

d. — Oxide of Iron in Hæmatin, Gastric juice, Urine.

4. Chlorine Compounds:—

a. Hydrochloric acid in the fluid of the stomach and Cæcum.

b. Chloride Sodium in Blood and Secretions; Brain, Muscles, Bone, Cartilage, Teeth, Pigment of eyes.

c. Chloride of Potassium in Blood, Crystalline lens, Saliva, Gastric juice, Urine, Milk.

d. Chloride of Ammonium in Urine, Sweat, Gastric juice.

e. Chloride of Calcium in Gastric juice.

5. Sulphates:—

a. — Potash in Urine, Gastric juice, Cartilage.

b. — Soda in Urine, *liq. Amnios*; Sweat, Bile, Cartilage.

c. — Lime in *liq. Amnios*; Bile, Gastric juice, Hair, Epidermis.

6. Sulpho-cyanide of Potassium in the Saliva.

7. Fluoride of Calcium in enamel of teeth.

8. Silica and Oxide of Manganese in Hair.

9. Alumina in enamel of teeth, Bones (?) and white hair (?).

10. Oxide of Iron in Hæmatin, black Pigment, Lens, and Hair.

11. Oxide of Titanium in the supra renal capsules. (Rees.)

Ammonia (Nitrogen, Hydrogen) and *Cyanogen* (Nitrogen, Carbon) do not exist in a free state in the organism, but as compound salts, and even then in excreted substances only (Urine, Sweat, Saliva).

Compounds exist likewise of inorganic bases with organic acids. (See Urine, Milk, Oil, Margoric acid.)

5. How the *ternary* and *quarternary* compounds of the elements which constitute the proper organic mass are brought about, has not been, hitherto, ascertained by inorganic chemistry, because it is not possible to analyse them in the common binary compounds, or to compose them from these. The most, besides oxygen, hydrogen, and carbon, consist also of nitrogen, and are

often of exactly similar composition, although very different in their characters. One essential distinction is in regard to the existence of nitrogen, upon which generally depends the rapidity with which they pass into a state of decomposition (become putrid).

We therefore distinguish :

6.

1. Nitrogenized Substances.

1. *Protein* (discovered by Mulder), $[C_{40} H_{31} N_5 O_{12}]$, in the moist state gelatinous; dried, brittle, and brownish; is scentless and tasteless, insoluble in water, spirit and ether; soluble in all dilute acids, and forms with a little *Sulphur* and *Phosphorus* the following (albuminous) bodies.

a. *Albumen*; $[Pr_{10} + P S_2]$, the most diffused of them, is, when dried, yellowish, brittle, soluble in cold water, coagulable by heat, creosote, spirits of wine, and unites insolubly with nitric and tannic acid, Plumb. diacet., alum., Corrosive sublimate, &c. It is found in Lymph, Chyle, Serum of blood, and especially in the Brain.

b. *Fibrin*; $[Pr_{10} + P S]$, readily coagulates (within 3—7 minutes), is fibrous, reteform; is present in a soluble condition in the blood, from which it is obtained by whisking it with twigs, coagulated in the muscles. Vegetable acids (and their salts) and caustic alkalies hinder the coagulation. Coagulated fibrin decomposes super-oxyde [Binoxyde] of Hydrogen in water, not albumen; the latter becomes violet with Hydrochloric acid, the former indigo blue.

c. *Casein*; $[Pr_{10} + S]$, soluble in water, pale yellow in solution, coagulates (membranous upon milk) by boiling (in flakes), by Alcohol, Acids (particularly lactic), and rennet. It is found in milk, blood, saliva, bile, and pancreatic fluid, lens.

d. *Pepsin*; (discovered by Schwann) $[C_{48} H_{32} N_8 O_{10}$ Vogel], in the gastric juice, in the parietes of the gastric glands, and upon other mucous membranes; precipitates by acetate of lead, dissolves with some acid, albumen and fibrin, very readily (digestion); is very like albumen; loses by coagulating the soluble property; also by bile.

e. *Globulin*; $[Pr_{15} + S]$, that is, the envelopes and nuclei of the (microscopic) blood corpuscles, without the coloring matter, insoluble in Alcohol; very like albumen. Is (according to Fr. Simon) Casein united with Hæmatin.

f. *Spermatin*; in the seminal fluid, is probably only fibrin; is soluble in water, becoming a clear fluid, which does not coagulate by boiling.

g. *Mucus*; consists of the secretion of the mucous glands, the cast-off epithelium of mucous membranes, and usually also of pus; swells up in water, is soluble in strong acids, and precipitated by tannin.

h. *Peculiar matter of tears*; dries in the air to a yellow, insoluble mucus; in acids and heat not coagulable.

i. *Keratin*; $[Pr S_2]$, the seemingly homogeneous matter of Epithelium, Hair, Nails, consists of different substances, like e, f, g, the chemical relations of which are not yet singly determined.

[NOTE. There are great doubts as to the existence of "Protein."]

2. Extractive Matters.

7. Not less diffused than the Protein compounds, is the animal extractive matter, which is particularly obtained from muscular substance (flesh), by

compression and inspissation, and hence called flesh extract. From this is again obtained: Water, Spirit (Osmazome), and Alcohol extract, according as it is extracted with water, spirit, or alcohol. To the materials soluble in water, merely, belong *Ptyalin*, the principle of saliva, colorless, scentless, and tasteless, soluble in water, forming a slimy fluid, and which is only precipitated from it by Alcohol. It is found only in *Saliva*, which changes Starch into Sugar, and Kreatin (Chevreul).

8.

3. Matter yielding gelatin

is produced by long boiling, from cartilages, the cartilaginous basis of bones from the membranes, tendons, and ligaments, and from the cornea. A solution of gelatin in boiling water becomes, upon cooling, a jelly. We distinguish the proper Gelatin (*colla*) [$C_{52} H_{40} N_8 O_{20}$], which is obtained from the membranes, tendons, ligaments, and the cartilaginous basis of bone, from the *Chondrin* [$C_{32} H_{26} N_4 O_{14}$] which exists in the cartilages of the nose, of the ears, the ribs, articular cartilages, and the cornea. (Pyine, the basis of pus [Tritoxyd of Protein $C_{40} H_{31} N_5 O_{15} + H O$], is said to be, likewise, a gelatinous substance.)

9.

4. Hæmatin, [$C_{44} H_{22} N_3 O_6 Fe$],

the colouring principle of the blood which is contained in the vesicles of the coloured corpuscles suspended in the serum, is obtained by boiling fresh blood, and evaporating it to dryness; the residue is then boiled with Æther, afterwards with spirit, when the red matter is precipitated in flocculi. In a pure state brownish black; contains Iron (also some oxyde of manganese); is soluble in alkalis. [Hæmatin may be obtained free from iron, as a red Pigment $C_{44} H_{22} N_3 O_6$]

10.

5. Principles of the Bile. (*Berzelius*.)

a. Bilin, the essential principle of bile, is, in a pure state, when dry, colourless, transparent, not crystallised, bitter to the taste, easily soluble in water, very readily metamorphosed; is decomposed by acids into Fellinic and Cholinic acids, Taurin, Dyslysin, and Ammonia. Its reaction is neither alkaline nor acid, but it forms with acids and bases easily soluble compounds.

b. Cholepyrrhin [biliphæin, Simon], colouring matter of bile, is sometimes found as yellow powder deposited in bile, or as concretions in the gall-bladder (gall stones); is bright reddish yellow, tasteless and scentless, contains nitrogen, colours water pale yellow, being a little soluble therein, more so in a ley of caustic potash or Soda, becomes at first bluish by Nitric acid, then green, violet, red, and finally yellow or yellowish brown. The (green) Biliverdin is a product of its metamorphosis by acids.

Mucus from the biliary passages and the Gall-bladder, causes a certain metamorphosis of the bile, is precipitated by Alcohol (also acetic acid).

Bilifulvin, the yellow colouring matter of bile, is a double salt of lime and of soda combined with an [organic] nitrogenous acid.

Extractive matter, Cholesterin, oleate, margarate, and stearate of soda, with some saponifiable fat. Chloride Sodium, sulphate, phosphate, and lactate of soda; phosphate of lime.

[The formulæ for the above do not appear to be accurately determined.]

11.

6. Urea and Uric Acid.

a. Urea [$C_2 H_4 N_2 O_2$], in the urine (with lactic acid); in ox blood; in the

blood, in *disease*, and in other fluids. Produced by Nitric acid, and again liberated by means of Carbonate of Baryta. Composition: corresponds with the cyanide of Ammonia with Water. Artificially formed by Wohler. Colourless, four-sided prisms, or long, silky, shining needles. Spec. grav. = 1.35. Scentless, it produces neither acid nor alkaline reaction; soluble in any proportion in boiling water. Unites as well with acids as with bases.

b. Uric Acid [$C_{10} H_4 N_4 O_6$], in the urine of animals feeding on flesh, in urinary calculi, and gouty concretions. United with ammonia in the excrements of birds (Guano) and serpents. Forms a light, fine, white powder; with difficulty soluble in water. Is precipitated from human urine upon cooling; at first grey, then pale, rosy red; or by the addition of nitric or muriatic acids. Uric acid easily decomposes urea, upon which a substance remains behind which Liebig calls Uric. Uric is one of the most feeble acids; its salts are little soluble in water. (Colouring matter of urine, an extractive, mixed with salts, is reddish brown, saltish bitter, urinous odour, soluble in water and alcohol, is of an amber or brownish yellow, easily decomposes. decreases when living on vegetable diet.)

II. Non-nitrogenized Materials.

12.

Sugar of milk, lactic acid, fats.

1. Sugar of milk, [$C_5 H_4 O_4 + H O$] *saccharum lactis*. $\frac{2}{3}$ of the solid constituents of human milk consist of sugar of milk. It may be procured by evaporation and crystallization from whey, that is, the fluid of milk deprived of fat and casein. It forms white four-sided prisms. Spec. grav. = 1.543. Taste slightly sweet, harder than cane sugar, easily soluble in water; changes, in time, of itself into lactic acid, as well as by rennet; by yeast it passes into grape sugar and spirituous fermentation.

2. Lactic acid *acidum lacticum*. [$C_6 H_5 O_5$] In all fluids and secretions of the body, freely united to Potash, Soda, Ammonia, Lime, and Magnesia. Free in the milk, urine, muscles, and sweat. It is colourless and scentless, very acid, not volatile like acetic acid, into which it is decomposed by strong heat; causes albumen and casein to coagulate, and holds phosphate of lime, the principal element of the bones, in solution. It is a strong acid, separating acetic acid from its compounds. Most of its salts are soluble in water, and crystallizable.

3. Fats (*Pinguedines*) are insoluble in water, in hot spirit and æther they form soluble compounds of Carburetted Hydrogen with a little oxygen. Most of them become metamorphosed by strong bases, especially alkalis and oxyde of lead, into soaps, as the acid contained in them with the base is transformed into a salt. We therefore distinguish the saponifiable fats from the unsaponifiable (*Cholesterin* [$C_{37} H_{32} O$], an element of the blood, of bile and of neurine, frequently present in gall stones and other pathological secretions,—and *Serotin* discovered by Boudet in the blood). Fat exists free in the fibro-cellular tissue and medulla of bones, or united with other substances, as for example in the milk, the brain, the hair, the cerumen of the ear, pus, &c.

The base of the saponifiable fats of the human body is *Glycerin*, [$C_6 H_7 O_5$] a substance separated by boiling fat with oxyde of lead; the acids which unite with that base form the different kinds of fat, *Stearic* (or tallow) [$C_{68} H_{66} O_5 + 2 H O$] and *Margaric* [$2 C_{34} H_{33} O_3 + H O$] acids on the one side, and *Elair* (oil) [$C_{44} H_{40} O_4$] acid on the other; lastly, *Butteric* [$C_8 H_7 O_3 + H O$] and *Cerebric* acids.

The solidity of different fats depends upon the proportional quantity of the above-mentioned substances. A preponderance of Elain renders the fat fluid, such as oils; Margarin constitutes the solid element of lard, whereof human fat is an example; Stearin of suet.

II. ELEMENTARY FORMS OF THE HUMAN BODY.

a. *Elementary parts.*

13. The first form from which matter is developed, and which lies as the basis of every organic structure (vegetable and animal), is, according to the general principle first enunciated by Schwann, 1838, the

Nucleated Cell, that is, a microscopical, delicately membranous vesicle, with fluid contents and a minute dark nucleus (Cytoblast) in one of its walls, surrounded by an amorphous, solid or fluid, substance (Cytoblastema or Inter-cellular substance), out of which the nucleated cell forms itself.

The *nucleus* is round or oval, rather flattened, yellowish red, smooth or granular, has a diameter of 0.002—0.004''' and probably first arises, as the granules are deposited from the amorphous mass about a central point, are circumscribed and blend together. About the nucleus formed from the mass a membrane is generated, the vesicle of the cell [cell membrane].

14. This process of development may at least be observed in the egg [germ] of vegetables and animals, in the formation and reproduction of certain tissues (for example, the nails and cuticle). Also in the blood, in pus, and in milk, the process is essentially the same. The formation of the elementary granules may be compared with the physical phenomenon, discovered by Ascher-son, namely, that when albumen was brought into contact with fat (oil drops) it coagulated in the form of a membrane, and enveloped them. But the vital and self-dependent progressive development of the nucleated cell is in no degree explained by this.

15. *Increase of the Cells.* The number of the cells in a tissue in the process of development, increases either by the origin of single new ones independent of one another (*e. g.*, in the hair, nails, inflammatory exudation); or by the development, in the interior of the old and mature, of new secondary cells, to which the contents of the primary cell serve as cytoblastema. (Thus, in the development of the liver, and in pathological growths; *e. g.*, Scirrhus.)

16. *Metamorphosis of Cells.* As the cells pass through various stages of development, they also present different circumstances in respect to their shape, position, contents, and chemical relations. In some tissues they maintain their independence, at most lying upon one another, and becoming thereby flattened, or

elongated and pointed (e. g., in the granular pigment, in the blood; in the muscular tunic of the intestines). Others attain a size of more importance (fat cells), or diminish in size (the lymph globules, if they become changed into blood corpuscles); they lose after a time their nucleus (the mature blood corpuscles); their parietes become thickened (cartilage cells).

17. In most tissues the cells blend together and coalesce. We find remaining,

1. The cavities of the cells unaltered, as their thickened walls blended together (in true cartilage, and osseous tissue), or the parietes impinging upon one another are broken through, so that continuous tubes arise (renal and seminal tubuli, perhaps also capillaries); or,

2. The cavities disappearing, their parietes lying flat together, so that the cells form solid laminæ, which appear to be spread out either in a membranous or fibrous form, according to the position.

Here belongs also the coalescing of complex (endogenous) cells [see before], which are transformed into the primitive fibres of the nerves, and the primitive bundles of the animal muscular tissue.

3. The nuclei of the cells elongate, coalesce, and thus form the "nucleus fibres," which, much stronger than the cell fibres, upon which they are found, are distinguished from them, also, by their insolubility in acetic acid. They are either rectilinear, spiral, or like a tendril, according to the position of the nucleus in the cell.

18. As the cells are dislodged from their situation, or become again formed into the homogeneous mass of cytoblastema out of which they arose, intervals are formed which are filled with fluids or air; these are the *intercellular passages*. They are circumscribed by layers of cells, and appear, after the metamorphosis of the cells into fibres, as canals and cavities (closed and open vascular cavities, lined with mucous membrane), with membranous or fleshy parietes. It is, moreover, a matter of indifference whether the structureless matter which also serves as a uniting medium be solid, as in the bones, or fluid, as in the blood. The conditions for the formation of proper tissues are given with the metamorphoses of the cells and nuclei; in a system of Histologia these must also be received as a basis, and not that, more or less composed of organs, as in the earlier systems. As however the number of facts is yet too small for the complete carrying out of a scientific arrangement, we must for the present observe a greater number of casual successions. In this point of view, therefore, anatomy can lay no claim to the name of a science.

b. *Individual tissues.*

19. External membrane, *Epithelium*.

The non-vascular and nerveless thin investment which covers

all the surfaces of the body, the external skin, as well as the interior of cavities and canals, is called *Epithelium*. (Formerly this term comprehended the covering of the mucous membrane only.)

It consists of a layer of independent nucleated cells, formed from the organic matter, which the highly vascular surface (matrix) lying immediately underneath it, deposits, and which increases layer by layer.

20. It does not merely serve as a defence to the tunic upon which it exists, but also for the reception and secretion of certain substances. Wounding it gives rise to neither pain nor bleeding.

According to the Elementary parts, three kinds are distinguished. (Henle.)

a. Pavement epithelium. Cells and nuclei roundish, oval, or where lying close to one another, multangular, and conjoined like mosaic. This most frequent variety forms thick layers, and is found upon the internal surface of serous membranes, of the vascular system, upon the mucous membrane of the mouth, the nose, or the globe of the eye. Upon the cornea of the eye it soon becomes dull after death, and appears as a white mucus, whence the dull appearance of the dead eye arises. The salivary mucus, also, consists in great part of this kind.

To this belongs also the Epidermis. See external skin.

b. Cylinder epithelium. Cells of a cylindrical or conical shape, the point of which is directed towards the mucous membrane, arranged like fibres. Nucleus generally between the base and apex of the cone.

They are present in man upon the mucous membranes only. In the alimentary canal they commence at the mouth of the stomach (*Cardia*), and terminate at the anus; being most distinct in the cylindrical glands of the large intestines. Upon the mucous membrane of the male organs of generation; at the opening of the salivary glands. In the gall-bladder they appear coloured green.

c. Ciliated epithelium is distinguished from the cylindrical simply in the fact of its possessing ciliæ at one of its extremities. The ciliæ themselves are variously formed. Longitudinal diam. of cell = 0.015 of a line, the ciliæ = 0.0018 of a line.

They exist in man upon the mucous membrane of the respiratory organs, the eyelids, the female organs of generation, and upon the parietes of the cerebral ventricles. It is obtained most readily from the nasal mucous membrane.

Ciliary motion. According to Purkinje and Valentin, the discoverers, it is of three kinds:—

1. The ciliæ move in the shape of an inverted cone, since their apices describe a wider circle than their bases.

2. The whole cilium moves in an undulating manner.

3. The apex curves like a hook.

A low temperature ($+5^{\circ}$ R.), acetic, strong mineral acids and bile arrest the ciliary motion. The stream of the fluid in which the ciliæ move is opposed to the direction in which they curve, and generally passes from within to without.

The object of the ciliary movements is not yet ascertained. In diseases, for example, catarrh, the ciliary epithelium is at first thrown off.

21.

Nails, *Ungues*,

are four-sided transparent plates of horn, rounded from before to behind, and from side to side, which are placed upon the dorsal surface of the last phalanx of the fingers and toes. They lie with their lateral edges in a fold of the corium. In the same manner the posterior border, the *root*, the length of which contributes one-fifth to one-sixth the length of the entire nail. The root extends about two lines deep into the fold, and is likewise surrounded above and below by the corium. The remaining portion, the *body* of the nail, is only united on the inferior surface with the corium; its anterior edge, the point of the nail, quite free.

22. The epidermis turns up at the root of the nail towards the fold of skin, without going deeper into it. By scalding the epidermis is loosened from the corium, and the nail with it.

23. The bed of the nail, *matrix unguis*, is the fold before mentioned, and the surface of the cutis which is covered by the nail. It determines the shape of the nail; is smooth above, below striated like the cutis. The striæ consist of elevated ridges which pass from before to behind, and upon which are placed cylindrical papillæ. The striæ become stronger towards the point of the nail and appear through, but the nail itself does not consist of parallel longitudinal fibres. Anteriorly the matrix is richer in vessels than at the root of the nail, where even a whitish semi-lunar mark (*lunula*) appears, whilst the rest of the nail is pale red.

The tissue of the nails is only distinguished from that of the Epidermis by its hardness and brittleness, which depends upon Phosphate of Lime (Lauth). It consists of flat, dry, non-nucleated cells, which, deposited in layers and spread out like a membrane, form plates, which run longitudinally. Corresponding to the *Rete Malpighi* of the Epidermis, we may here also remark a soft and white layer, particularly in young children. In old people indented, undulating transverse striæ appear upon the nails, particularly of the toes.

The nails are first distinguishable in the fifth month of fetal life by their firmness, but even in the third month the fold fixes their limits.

The growth of the nail takes place from the *matrix*, and the old parts are pushed forwards by the younger, from the roots. They may reach the length of two inches. In many diseases (e. g., Typhus) they fall out, in others (as *Phthisis pulmonalis*, *Plica Polonica*) they become thickened and curved. After falling out, the surface of the matrix becomes covered with a thin horny layer, which is always more thickened over the recess of the *lunula*.

24.

Granular Pigment,

improperly denominated black pigment, is, like the preceding, a nerveless and non-vascular tissue, for which the highly vascular membranes upon which it appears serve as a matrix.

25. It exists to the greatest extent among the coloured races, especially negroes, the entire surface of whose bodies is covered with it. It here lies between the *cutis* and *rete Malp.* of the epidermis. It is not black, but dark brown, and thus gradually proceeds even into yellowish. Among the Caucasian tribes it is especially found in the eye on the posterior surface of the iris. Moreover, also in the healthy state about the female nipple, on the skin of the scrotum, of the great labia, and of the anus, in the Bronchial glands; in pathological conditions, as Freckles, and in scirrhus growths.

The pigment tissue consists of globular, multangular, or tubular, elongated cells (pigment cells) in which the coloured particles lie (pigment corpuscles). The pigment from the internal surface of the Choroid coat of the globe of the eye is the best for examination.

The cells are destroyed by putrefaction, and are soluble in acetic acid; the pigment granules pass out, as extremely small, flat points, which, only when they are heaped together, present a yellowish red and brownish appearance. They are only soluble in caustic Potash, and become changed in colour by Chlorine.

The ashes of the Pigment consist of muriate of soda, lime, phosphate of lime, and oxide of iron. The purpose fulfilled by the Pigment in the skin cannot be decided; in the eye it serves to protect it from too strong light. Pigment is wanting in the eyes as well as in the hair of Albinos.

26. Hairs, *Pili* s. *Crines*,

are thin, hard, elastic, and thread-like cylinders of various colours. Non-vascular and without nerves like the foregoing tissues, they must, however, on account of their more complicated structure, be considered as more highly organised. They are also nourished by a highly vascular basis, which is regarded as an inversion of the *cutis*.

The whole external surface of the body is covered with larger or smaller hairs, with the exception of the palms of the hand, the sole of the foot, the lips, the superior eyelid, the foreskin, Glans penis, and Clitoris.

Structure. The roots of the hair lie deeply in the *cutis*, surrounded by the hair follicle, and seated with the soft club-shaped bulb upon the germ of the hair (*Pulpa*). The body or shaft of the hair projects beyond the surface of the body, and terminates in a free point.

In the shaft two substances are distinguished:—

a. The *Cortex*, is transparent and smooth, striated longitudinally, fibrous, especially towards the roots. The transverse striæ, which are observed upon it, consist of encircling scales, which may be detached by the action of Sulphuric Acid.

b. The *medullary substance* is wanting at certain points in coarse, and sometimes altogether in fine hair. It consists of small globules, resembling fat drops, is dark, and never found in the point of the hair. Diameter

= 0.017 of a line. The length, thickness, and shape of the shaft vary considerably with individuals and in different parts of the body. The free extremity is frequently split.

The hairs of the head are generally cylindrical, frequently also flat and very curly (woolly hair of Negroes).

The beard and pubic hairs, those of the axillary fossa, of the eyebrows, the entrance to the nose and the ears, are oval (upon transverse section).

The root of the hair, bulb (head of the hair according to Henle), *bulbus pili*, is soft, viscous 1—2 lines long, below thick and hollow, containing a tenacious substance, in which cell nuclei lie (as in the rete Malp.); farther upwards, surrounded by transverse fibres, which connect firmly together the longitudinal fibres; the superior extremity is uninterruptedly connected with the shaft of the hair. The Medulla by degrees loses itself below.

Outside the shaft of the hair the sheath of the root passes from the bulb, which immediately continues into the Epidermis, of which it is only an inversion, just as

The Hair follicle (folliculus pili) is an inversion of the Corium. This consists of fibres of areolar tissue, and terminates blindly, with a process above (Pulpa), upon which the hair bulb is seated. It possesses nerves and vessels, pain and blood, therefore, on wounding. Into it open the smallest sebaceous (gland of the hair follicle) glands. (See, under Cutis.)

Characters. Hairs become electrical by rubbing, and attract moisture both from the air and body. They are therefore soft and shining in perspirable, and brittle in dry skins.

Chemical. Hair consists of fat and Keratose substance, the former probably coming from the medulla, the latter from the cortex. Boiling alcohol draws out the fat containing the colouring matter, Elaine. It is acid; red in red, and greyish green in dark hair. Nitric acid dissolves the hair, chlorine bleaches and makes it glutinous. In the ash we find some oxide of iron, oxide of manganese, and silex, together with sulphate, phosphate, and carbonate of lime.

Growth. Hairs grow out of the highly vascular follicle, and are renewed, like the nails, by deposits from below. The cut off point is not again restored, but the piece immediately next to it is pushed from below forwards; the point is also the first part generated. The first development appears after the third month of fetal life; even before birth the entire body is covered with woolly hair (lanugo), which at a later period falls off.

With puberty the beard and pubic hairs are developed, the hair in the axilla, *glandebalæ*, and on the chest.

NOTE. The skin of the head produces most hair (= 293 on $\frac{1}{2}$ a line square), more fair than brown, and more brown than black. The hair follicles generally lie in twos and threes in regular lines, for which a fixed point, *e. g.*, the crown of the head, serves as a centre.

In old age the roots of the hair become knotty; the shaft, from deficiency of oil, grey; and the hair falls off. White hair is also found on Albinos.

NOTE. Hair is sometimes found abnormally upon the mucous membrane of the eye, in the gall bladder, in the ovaries [and in the thorax. Preparation shown to me by Dr. Munk. TRANS.]

27. To the so-called non-organised tissues, the laminated structures (Burdach), belong the Cornea and crystalline lens of the eye. (To which refer.) Nearest to these we may comprehend:

28. The uniting tissue (J. Müller) cellular, areolar or fibro-cellular, a soft humid mass, penetrated by vessels and nerves, which is diffused every-

where throughout the body, serving partly as a uniting, partly as an enveloping medium for the organs and their elements. It possesses a fibrous interlacement, is very elastic and translucent, and by boiling is metamorphosed into Gelatin (?).

Structure. Uniting tissue consists of long and probably solid fibres, which, held together by amorphous blastema, and generally united into white bundles, become transparent by acetic acid. Dark *spiral filaments*, which are not made transparent by acetic acid, wind themselves in a serpentine arrangement about each bundle, and are probably developed from nucleus fibres, just as those of the first from fibres of the cell vesicle.

29. We distinguish two kinds of uniting tissue :

1. **Amorphous.** It is loose and fills up the intervals between the organs and their parts, for example, between the lobes and lobules of the liver ; it lies in great masses under the Cutis, and forms cells, in which air and fluid may collect, or in which fat vesicles are deposited. Vessels and nerves traverse it in larger or smaller numbers. Burdach calls the uniting tissue which envelops the exterior of organs *atmospherical* (thus the subcutaneous areolar tissue), and that which enters into the organ *parenchymatous*.

2. **Figurate.** It forms membranes, bladders, cords, and discs ; is fibrous, and the more even and brilliant the thicker its tissue. Of it we may distinguish two kinds :

a. **Not contractile, uniting tissue (fibrous or tendinous).**

1. **Tendons.** They are very dense and strong, little elastic, and long resist decomposition and chemical influences ; they contain 0.62 water. Where tendons pass over bones, a loose uniting tissue with coarse meshes surrounds them (Synovial sheaths), in which a glairy clear fluid is contained (Synovia).—The tendons (sinews) are adherent to the muscular fibres, from which they are only prolonged, and to which they are firmly attached by uniting tissue.

2. **Ligaments, ligamenta,** are quite similar to tendons, but generally flat. To this class belongs the round ligament (*lig. teres*), which assists in maintaining the head of the femur in the acetabulum ; the *membrana obturat.* of the thyroid or oval foramen of the *oss innominatum* and the *memb. interossea* form a transition towards the fibrous membranes. The elastic and interarticular ligaments of the vertebral column do not belong to this class. (See Syndesmology).

3. **Ligamentary discs.** [Interarticular cartilages, Glenoid ligaments.] Very strong, and therefore formerly enumerated with the cartilages which, moreover, are less elastic. They are intended to prevent the pressure of two cartilaginous surfaces upon one another, on which account they are also invested with Synovial sheaths. Tendinous fibres, which pass off from the borders, are attached to the articular capsules or cartilages.

Ligamentary Discs are found in the articulations of the jaw and knee ; in the superior eyelid (tarsus, the so-called cartilage), around the articular fossæ of the acetabulum and scapula (*labra cartilaginea*).

4. **Fibrous membranes.** To this class belong :

The external coverings or case of many viscera, serving as a defence for the Parenchyma, or for the attachment of muscles, *e. g.*, the *Sclerotica* of the eye, the *Albuginea* of the testis, *Dura Mater* of Brain and Spinal cord, the covering of the pericardium, of the kidneys, ovaries, spleen, clitoris, and urethra.

The tendons of the muscles attached are interwoven with them. Their tissue consists of separate fibres, or of more or less interlaced bundles. They are covered with epithelium.

The tendinous expansion of the Diaphragm.

The *membrana tympani*.

The valves in the heart, the veins, and in the lymphatics.

The neurilemma, that is, the envelope which surrounds the nerves.

The fasciæ. They are developed from the amorphous layers of uniting tissue like membranes, and envelope the muscles passing into the intermuscular ligaments, and from these into the periosteum (*ligament. Cruciata*), or into the tendons of muscles (*fasc. rect. abdomin.*)

Periosteum (membrane covering the bones), and *Perichondrium* (that covering the cartilages). They surround the bones and cartilages externally, and are attached to these, from the first, by the extremely numerous vessels connected together by areolar tissue, of which they consist. In the cavity of the bones the periosteum is with difficulty separated from the epithelium lying upon it.

5. *Tunica propria* of the intestinal canal, of the gall and urinary bladders, the pelvis of the kidneys, the ureters, &c., is a peculiar membrane (*T. nervea, vasculosa*) of uniting tissue, which lies between the muscular layer and mucous membrane; shining white; almost inseparably connected, externally, with the uniting tissue of the muscles; internally, with that of the mucous membrane.

6. Serous membranes. They serve as the boundaries of cavities inside the body, and are generally quite closed. Henle makes a distinction between true, that is, such as are covered on the outside with (pavement) epithelium, and false, in which it is wanting.

To the false belong the *Bursæ Mucosæ* of muscles, tendons, and membranes; these are closed sacs, filled with watery or viscous fluid, which lie between muscles and bones (*capsulae synoviales*).

The true serous membranes consist of a layer of Epithelium (generally pavement, only in the tubes of the Uterus ciliated), and of fibrous uniting tissue, which approaches at one time fibrous, at another time elastic tissue. The separation of the subserous uniting tissue is, almost in all cases, only artificial.

They not only serve for lining cavities, but also as the envelopes of the organs which lie in them. But it is not essential that they should be, everywhere, entirely closed. (The peritoneum of the female is open at the extremities of the Fallopian tubes.)

To this class belong: Plura and Peritoneum, Pericardium, Arachnoidea, Tunica Vaginalis. They lie in the cavities as *sacs*, the external surface of which is attached by plain uniting tissue, partly to the walls of the cavities, partly passing over upon the organs, which forms a sort of inversion of it; the internal surface is smooth, covered with pavement epithelium, and secretes a thin, watery, albuminous fluid, *Serum*.

The sacs form folds, ligaments, and rete, particularly at the places where the vessels and nerves are allowed a free thoroughfare to the organs enveloped by them. The vessels and nerves become, therefore, covered by uniting tissue and epithelium, but they do not perforate the serous sacs.

The serous membranes do not pass merely into fibrous, but also into mucous membranes (e. g., mucous membrane of the tympanic cavity).

7. The vascular membrane of the brain (*Pia Mater*), and that of the eye (*Choroidea*), that is, a membranous uniting tissue as a support for vessels which nourish another organ. *Pia Mater*, like *periosteum*, is firmly connected with the brain, into which its vessels penetrate, and consists of loose bundles. *Choroidea* resembles the Corium, which serves as a *Matrix* for the Epidermis.

It is dense, strong, and smooth, and only made adhesive by the black Pigment which it deposits.

Vessels and nerves of figurate, non-contractile uniting tissue. Vessels which not only go through, but belong to the uniting tissue itself, are found in small numbers in the strong structures (tendons, fibrous membranes); in larger in the serous, the proper, and vascular membranes. Moreover, the quantity of the vessels in one and the same membrane differs according to position (*e. g.*, the synovial membrane is more highly vascular at that part where it covers the fibrous articular capsule, than upon the cartilage).

Nerves are not found in the tendons (therefore they are not sensitive); such as are found in the fibrous membranes do not probably terminate in their substance. Whether nerves passing to serous membranes remain in them, is also still doubtful, although it is a fact that peritonitis or pleuritis is very painful.

b. Contractile uniting tissue, that is, such as contracts upon irritation. To this class belong:

1. The external skin, *Cutis* and *Corium* (which see).
2. *Tunica dartos* (see *Splanchnol.*), the wrinkled, reddish membrane on the posterior surface of the Scrotum, of fibrous tissue, which consists of a network of longer meshes, since the longitudinal bundles of uniting tissue anastomose. (*Septum Scroti* consists of fibrous and common uniting tissue.) It is remarkable for its vascularity and contractility, without muscular fibres.
3. The tissue of the *Corpora Caverosa*, of the penis and Clitoris, of the *corpus Spongiosum urethrae*, consists of a dense network of very extensible, but strong, flattened, or roundish bundles of uniting tissue. A fibrous sheath envelopes and separates the two cavernous bodies. From it (*tunica Albuginea*) larger or smaller laminae and septa extend inwards into the above-mentioned network: each lamina is provided with a blood-vessel.
4. The contractile tissue of the longitudinal and circular fibrous coat of the veins and lymphatics (which see).

The movement of the contractile tissues is not the consequence of a merely physical elasticity. The external skin, when it contracts, becomes thickened, shortened, and sinks in; the openings of the hair follicles therefore pass out (goose-skin), the hair stands on end. The same with the nipple.

The Scrotal skin lies in transverse folds, when the longitudinal fibres of *Tunica Dartos* contract.

The Penis shrinks up, becomes harder and firmer, and the blood retires, when the cavernous tissue contracts.

The development of uniting tissue takes place from nucleated cells, as may be demonstrated, which, according to Schwann, become pointed in two opposite directions, and in this manner form spindle-shaped fibres, from which finer ramifications pass off.

Uniting tissue is very readily regenerated; its lost substance is replaced by a scar (*cicatrix*), which in loose parts is more firm, in tendinous less so.

The fluid (serum) which we find in uniting tissue, is no secreted product from it, but is the fluid of the blood which penetrates the parietes of the vessels therein, and so much the sooner collects together the looser it is (*e. g.*, in dropsy of the scrotum, about the ankles, &c.)

In like manner, the fat is still less a secretion of the *uniting*, but, a proper tissue.

30. The Adipose Tissue,

has only of late been recognized as an independent tissue, particularly by Gurlt, whilst formerly, misled by the appearance of the fat vesicles in the cellular interspaces of the uniting tissue, we were accustomed to regard the latter as the organ for the secretion of the fat. But even the divided portions of fat, surrounded by uniting tissue, have their own proper cells separated from it.

Distribution. The fat tissue appears connected together like a membrane, especially in the uniting tissue under the corium, as the most inferior layer of which (fat membrane, *Panniculus adiposus*) it is considered; more abundant in children and women than in the aged and men; in greatest quantity under the sole of the foot and on the mammary gland. Less perfectly formed and more collected together in masses it presents itself in the orbits, and as marrow in the medullary cavities of the cylindrical bones. Accumulated immoderately in all the usual places, general corpulency results; in separate or uncommon regions it is present, as lipoma (fatty tumour).

Structure. The fat tissue consists of cells, in which a dropping fluid, the fat, is contained. The cell is, inside the body, oval and smooth, becomes irregular on cooling, angular or flat. Diam. = 0.018 of a line to 0.056. Their surface refracts light strongly, the edges are bright silvery white when light falls upon them. The vesicle is very delicate; in its wall an oval nucleus generally appears (even two). The cell becomes smaller, and is entirely soluble in acetic acid.

Development. Fat forms and becomes consumed very quickly, probably in consequence of the fat-cells being dissolved (especially in dyscratic diseases and after blood-letting), and the fat taken up by the lymphatics and carried into the blood.

31. Elastic Tissue, *tela elastica*,

is when of some thickness yellow; elastic but fragile, closely allied to the uniting tissue; does not change into Gelatin by boiling (Berzelius), is insoluble in concentrated acetic acid, soluble in dilute sulphuric acid, and is precipitated from the solution by Infus. of Galls, but not by ferro-cyanide of Potassium.

Distribution. The Elastic appears in connection with other tissues, but also independently, combined as membranes and flat ligaments, in—

1. The yellow ligaments of the vertebral columns: *Lig. flava, obturatoria atlantis*.
2. The ligaments and membranes of the *Larynx*, the *Trachea*, and the *Bronchi*.
3. The elastic fibres of the *Œsophagus*, in the *cutis*, many *fasciæ* and *serous* membranes.
4. The external (not central) coat of the arteries (and veins?). See Angiology.

The fibres of this tissue are strongly serpentine, like the nucleus fibres of uniting tissue (both insoluble in acetic acid); or curved and curled, of an S shape (in the *ligg. flava*); or anastomosing with parallel, neighbouring fibres (in the arterial coat). The fibrous appearance is not so distinct as in the structures consisting of uniting tissue. It is commonly mixed up with uniting tissue; the purest is presented by the yellow ligaments.

* Few vessels are found therein; nerves, probably, not at all.

Uses. Connection of bones, for the boundary of cavities, envelope of muscles, the last being assisted in their performance by the very extensible elastic tissue.

32.

Cartilage tissue.

Cartilage, *cartilaginee*, *χόνδροι*, are smooth, firm, elastic and flexible, more or less brittle parts, of a milk blue, even yellow, colour, of spec. grav. = 1.15; consisting of a homogeneous basement substance, between which vesicles are scattered, or even fibres are found. We accordingly distinguish:

1. True cartilages, that is, such as consist of homogeneous basement substance, containing cavities and cells with (from 1 to 4) nuclei, but seldom cells containing fat. They are covered with a strong membrane of uniting tissue, *Perichondrium* which contains vessels, on their free surfaces. To them belong,

- a. The Nasal.

- b. Cartilages of the respiratory organs (except, *cc. Santorini, arytenoid, epiglottis, corusc. triticea*, and *ligg. hyothyroid. lateralia*).

- c. Rib cartilages and cartilage of *proc. xiphoideus*.

- d. Articular cartilage (except the ring around the *cavitas glenoidalis*, and the *condylus-maxill. inferior*).

The rib cartilages break transversely very easily, and incline to ossification, whilst in them, as in the thyroid cartilage, fibres become developed, which are at first pale, later yellow and stiff. They lie close together in bundles, and receive the cartilage cavities between them. Thus arises the transitional form into

2. Fibro-cartilages, *cc. fibrosæ*. Their basement substance consists of darker, harsher, and stronger fibres than are present in the true cartilages; they are more flexible (do not break so easily), and more yellow, containing nucleated cells holding fat (hence an inclination to be transformed into fat). To them belong:

Ligg. intervertebralia, Synchondroses, Ear cartilages, Epiglottis, cartt. Santorini, and Wisbergii, cart. tubæ Eustachii, c. interarticular. of the sterno-clavicular articulation, the *Meniscus* of the maxillary articulation. The so-called fibro-

cartilaginous mass in the space between Petrous, Sphenoid, and Occipital bone (*foram. lacerum anterius*) consists of pure uniting tissue.

Chemical. The principal element of cartilage is Chondrin, which arises after boiling true cartilages from fifteen to eighteen hours, and false, which is well supplied with cartilage cells, for forty-eight hours. Cartilage contains about three-fourths water, nevertheless it does not readily decompose. Salts; Carb. Soda (most); Sulphate of Soda, Chlor. Soda, phosph. Magnes.; some oxyd of Iron.

Vessels and nerves. Most cartilages are without vessels, but in connection with highly vascular bones and synovial capsules. From out of the Perichondrium vessels pass into the (true) cartilages, *e. g.*, the ribs. Also the Synchondroses (*Symphysis pubis*, &c.) are said to contain vessels during pregnancy. In the ossification of the thyroid, rib, and fetal cartilages new vessels form. The articular cartilages never ossify, but become rough and degenerate; in consequence, the immediate ends of the bones grow together (Anchylosis). Cartilage is not sensitive, possessing no nerves.

Upon bone cartilage, see Osteology.

33. Nutritious Juice

consists of a fluid portion, Plasma, and of a solid, the microscopical corpuscles which are suspended in the former in great numbers. Plasma (*lig. sanguinis et lymphæ*) is a homogeneous mass which at death divides into a fluid (serum) and a coagulable portion which forms by enclosing the corpuscles, the blood or lymph clot, coagulum (Cruor. Placenta).

The corpuscles pass through, in a short time, several stages of development, like the Organismus, to the maintenance of which they contribute. As the last stage, as modifications (certainly only imaginary) of the nutritious juices, we must consider those which are designated by the expression Blood, Chyle, and Lymph.

The analogy between the Plasma and Cytoblastema, the corpuscles and nucleated cells, has already been referred to.

34. 1. CHYLE, *Lymph*.

1. Chyle. This is the milky fluid formed as the result of the digestion of nutritious substances in the intestines, and taken up from them by the lymphatics (lacteals). It immediately takes its course with the lymph, which very soon unites with it, through the large lymphatic trunks, and thus passes into the sanguineous system.

The Chyle at the commencements of the lymphatics [lacteals] (where it is not, however, even more free from lymph) has a milk-white colour, which depends upon fat globules, and does not coagulate. It contains besides

the fat (C. H. Schultz), very small, generally round corpuscles (nuclei of blood corpuscles?), which increase the more the fat diminishes; the relative quantity of fibrin and albumen is smaller than in lymph.

35. 2. Lymph is the fluid of the lymphatics, flowing into the system of blood-vessels, formed from the surplus of the blood plasma and the destruction of the particles of organs.

A thin fluid, colourless, sometimes yellowish and lastly red; alkaline reaction, and saltish taste. Contains larger corpuscles which, round and smooth, are rather larger than the blood corpuscles (see after), of about 0·002 to 0·005 of a line diameter; their shell soluble in acetic acid, the nucleus insoluble; and smaller, that is, nuclei without cells; the Plasma of lymph contains fibrin which coagulates of itself, after ten to fifteen minutes, into a lymph coagulum which encloses, partly, the corpuscles.

The Serum consists of 92 to 96 parts water, albumen, alkaline salts, and oxide of iron. The small lymph corpuscles, cell-less nuclei, are metamorphosed into blood discs, but not so the perfect lymph globules.

36.

2. BLOOD, *Sanguis*,

a bright red fluid in those vessels called arteries, a dark red in the veins, of 1·052 to 1·057 sp. grav. (at + 15° R.), [65° Fahr.], and saltish taste, easily decomposes. Living blood consists of fluid (Plasma) and blood corpuscles.

Out of the vessels the blood coagulates after 5 to 7 minutes, and separates into a firm portion (coagulum, Placenta), and into a fluid (Serum); the coagulum contains the coagulated fibrin, and the (red) blood corpuscles, the yellow serum, the albumen, and the salts of the blood.

1. Blood corpuscles. Coloured and colourless are now distinguished.

a. The coloured, singly yellow, in heaps appearing red, are very smooth and slippery; in the human subject flat, round, of 0·0025 to 0·0032 of a line diam. (broad), and of 0·0008 to 0·0012 of a line diam. (thick); very elastic, soft and heavier than the plasma. A nucleus (as we see in the blood corpuscles of the frog, which are four times as large) is rarely or never observed in those of man.

The substance of the nucleus is fibrin (J. Müller, Fr. Simon). The case is very sensitive, swells out in water and principally in less concentrated fluids than the Serum; shrinks together in concentrated solutions, and is soluble in acetic acid.

Inside the case we find a viscous fluid, in which, probably, the colouring matter, soluble in water, is contained (Hæmatin and Hæmaphæin), which amounts to about 0·55, and may be abstracted by alcohol. The Globulin (Berzelius) is also a part of these contents, probably albumen with phosphate of lime. The cases of the blood corpuscles have not yet been chemically examined alone.

Cruor (not to be confounded with Hæmatin), blood red, is the term given to the mixture of the cases with their contents.

b. The colourless blood corpuscles are somewhat larger than the coloured; they possess a nucleus, and are more frequently present in the serum than in

the blood coagulum. They are developed from the Chyle and Lymph corpuscles, and are metamorphosed into coloured blood corpuscles, without nuclei.

2. Blood Plasma, the fluid element of the blood, contains, dissolved in water:

a. Fibrin, more in males, in pregnant women, and in inflammations, particularly of the lungs.

b. Albumen, more in females than in males.

c. Fat, in indefinite quantity; the greater the quantity, so much the more white the serum.

d. Extractive matters.

e. (Peculiar smelling substance, which is especially brought out by sulphuric acid, and may serve to distinguish between animal and human blood.) (Barruel.)

f. Salts: 1. Soda and lime, with lactic, fatty, carbonic, sulphuric, and phosphatic acids; particularly chlor. sodium (common salt).

2. Lactate ammonia.

3. Phosphor. Lime and Magnesia.

Oxide of iron is found in the blood in very indefinite quantity, only. Bile, urea, as well as sugar also, are found probably only in diseased blood.

Although the composition of the healthy blood differs according to the age, sex, &c. of man, there always remains, nevertheless, a certain relative proportion of the elements before quoted. F. Simon gives the following proportions as the result of an analysis of healthy venous blood.

1000 parts of blood consist of:

Water	791·900
Solid residue	208·100
Fibrin	2·011
Fat	1·978
Albumen	75·590
Globulin	105·165
Hæmatin	7·181
Extractive matter and salts	14·174

The arterial blood contains less solid elements, less fat, albumen, hæmatin, extractive matters, and salts. The blood also of ven. porta., that of the hepatic veins, &c., present each again particular differences.

Coats of vessels, see Angiology.

Muscular tissue, see Myology.

Tissue of nerves, see Neurology.

37.

Tissue of Glands.

Glands, *glandulæ*, was the name formerly given to all soft, roundish, highly vascular organs, with or without excretory ducts. They are organs of the most different sizes, which take away certain substances from the blood, for the purpose of conducting them (as such or metamorphosed) either immediately to the surface of the body, or first into cavities, where they become mixed with their contents. They are therefore divided into membranous and vascular glands.

1. Membranous, or glands of mucous membranes, possess a

cavity which constantly, or at times, is in communication by canals or immediately with the surface of the body. The most simple are round vesicles (cells) clear as water, of 0.01 to 0.03 of a line diam., formed of a structureless membrane, with granular contents and closed, lying in the substance of the mucous membrane, without elevating it. Similar, but larger, are the *gl. tartaricæ* of the gums, *gl. agminatæ* and *solitariae* of the small intestines and the egg in the ovary. They open at times. We therefore distinguish simple (*gl. simplices*, *cryptæ*) and compound glands (*gl. compositæ*), and among these *gl. conglomeratæ*, which form a mass, with one or few excretory ducts, and *gl. aggregatæ*, which only lie close together, and possess separate excretory ducts. Forms of glands:

a. Glands like blind sacs consist of a series of vesicles opening into one another, the first of which is closed, whilst the last opens upon the mucous membrane or into an excretory duct. The shortest are the glands of Lieberkühn in the small intestines, filled with viscous granular contents; they are longer upon the large, particularly in the *rectum*. More in clusters, but unarranged, appear the *gl. pyloricæ* (gastric fluid glands), the *gl. Meibomianæ* of the eyelids, and the glands of the *caruncula lacrymalis*. Wound up like a ball of thread, convoluted: sweat glands of the skin and the ceruminous of the ear.

b. Glands in the form of a bunch of currants, racemose; are so composed, that single vesicles are united into one lobule with a common excretory duct. The primary lobules are associated together by uniting tissue into larger secondary, and these into tertiary, which all communicate by the common trunk of the entire gland only. The whole gland possesses a more or less condensed covering of uniting tissue, never a serous. These racemose glands are distinguished from one another, only, by their mass, size, and the ramifications of their excretory ducts. The lacrymal, mammary, and prostate glands are remarkable, since in them a common excretory duct is wanting, and the mass of several gland lobules appears joined together. Besides these and the accumulated (*gl. conglobatæ*) Tonsillæ, to this class belong the small mucous glands of the lips and cheeks, of the palate, tongue, and œsophagus; of the Larynx, Trachea, Bronchi, *gl. Brunnerianæ* of the small intestines, the mucous glands of the Vagina; the salivary glands, the Pancreas; *gl. Cowperi* and *Bartholinianæ*.

c. Reteform glands consisting of tubes (therefore *gl. tubulosæ*), which, like the blood-vessels, are united by anastomoses into a network, and never or rarely terminate blindly, being, besides, many times convoluted. Their excretory ducts open into bladder-like receptacles for the secretions (as in the liver). To this class belong the kidneys and testicles. They are surrounded by a fibrous membrane, which in the last sends septæ inwards, so that the lobules may be distinguished.

The vessels of the glands are very numerous. In the Liver, Kidneys, and Testicles they pass in and out at the *Hilus*; in the rest of the glands they are distributed from different points upon the surface, since they follow the uniting tissue between the lobes, lobules, and tubules.

Nerves form plexuses upon the arteries, and accompany these into the interior of the glands.

2. Vascular glands. These are the Thyroid and Thymus glands, Spleen and Caps. supra renales. They are soft, round, or lobulated, pale or dark red, without excretory ducts. In the thyroid and thymus glands small cavities are found filled with a milky fluid. The parenchyma consists, in all, of granules which fill up the spaces between the vessels. They are, proportionably, not superabundantly, provided with blood and lymph vessels. In the spleen and supra renal capsules the vessels quickly pass into capillary ramifications, without marked anastomoses. In the supra renal capsules a greater abundance of nerves prevails. It is pretended that their function consists in producing a change in the composition of the blood; of what kind is unknown.

With these may be classed the Lymphatic glands, which consist of a convoluted arrangement of Lymphatic vessels passing uninterruptedly through them (*vasa afferentia* and *efferentia*). The alteration effected in the blood and lymph as they pass through them is even still doubtful.

SPECIAL ANATOMY.

38. *General cutaneous covering of the body.*

The external surface of the body is invested by a compound membrane, which, at the openings of the internal surface, turns inwards, and lines the open cavities, as mucous membrane.

39. I. External skin, *cutis*.

It invests the whole of the outer surface of the body, is itself covered externally with the *epidermis* (see Epithelium). internally with loose uniting tissue, and consists of a very filamentous, interwoven uniting tissue, with glands, nerves, and vessels: this is the *Corium*.

1. *Epidermis*, cuticle, is a connected, nowhere perforated, more or less strong layer of pavement epithelium. Its usual thickness measures one-twentieth of a line, but in the palm of the hand and under the sole of the foot equals $\frac{1}{2}$ to 1 line. In life colourless and diaphanous, it becomes in death white and transparent: is little elastic, but brittle, curling up together when detached from the cutis, peels off, especially in cutaneous eruptions, and rises in blisters on the application of heat. It does not decompose; it is coloured by sulphuric acid, brown, by nitric, yellow, by hyd. chloric, not at all, by nitrate of silver, first milky white, then greyish blue, by hyd. chlor. of gold, purplish red. Caustic alkalies dissolve it. Elements:—keratin equal to 0.94, gelatin equal to 0.5, lactic acid, sulphate, phosphate of potash and lime.

The unevenness of the epidermis depends upon that of the corium which is found underneath it. There are elevations, grooves and fossæ, from the last of which hair, sweat or fat, with which the cuticle is constantly saturated, appears. By boiling, the epidermis easily separates, especially in the palm of the hand or sole of the foot, into an external and an internal layer. The internal layer (*rete Malpighii*), improperly regarded as a peculiar membrane, is softer, but not essentially different from the external layer, into which, by degrees, it passes; its reteform appearance arises from rearing out the nervous papillæ of the corium, otherwise it is granular, whilst the external layer appears striated. In the Negro the *rete Malpighii* is, likewise, nothing else but this internal layer with black pigment adherent to it.

2. *Corium*, true skin, is a soft, at the same time strong, dense, and very extensible organ, of a red colour and variable strength; thickest in the surfaces of the foot and hand, stronger in the male than in the female, and very delicate on the eyelid and the glans penis. Upon its external free surface we observe folds, especially in places which are subject to extension (in the palm of the hand, upon the dorsum of the fingers, on the foreskin). Other folds are formed by means of the muscles, which act upon the skin (e. g., on the forehead). These, in time, remain constantly (as wrinkles), like the folds which arise upon the abdomen, in consequence of the greater extension, after pregnancy and dropsy; in old age they arise from the loss of the fat.

The skin is moveable by proper cutaneous muscles (in man on the face and in the hand only); by a very fatty, as well as expanded uniting tissue in the form of a membrane (*fascia superficialis*). See Myology.

The external skin is both an organ of touch and of secretion, by means of the tactile papillæ, arranged in rows, upon the linear elevations, the sweat and sebaceous glands, and the glandules of the hair follicles found in the depressions between them.

a. Tactile, sensitive papillæ, *Papillæ corii*, consist of closely compressed fasciculi of uniting tissue, in the interior of which a vascular and nervous loop passes. (The nerves do not terminate like a hair-pencil or club, but are reflected, and return to the surface of the skin.) The Papillæ lie in the uppermost layer of the Corium, covered by the Epidermis, which fills up, partly or entirely, the depressions between them, and therefore gives to the skin either a grooved or even appearance. We distinguish filamentous and club-shaped papillæ. The finer they are, so much the more crowded they stand, and the more sensitive is the skin (e. g., on the inner surfaces of the fingers, in the sole of the foot, on the nipple, the lips, glans penis, and clitoris).

b. Sebaceous follicles, *folliculi sebacei*, spread over the whole surface of the body (with the exception of the palm and sole), found especially at the points of transition of the external skin into the mucous membrane. The larger open immediately upon the skin, namely in places devoid of hair (e. g., the glans penis, the nymphæ); they do not consist, probably, of simple follicles, but must be enumerated with the racemose glands; the smallest lie in pairs on either side of a hair follicle, and open immediately into it. These last consist of small fat cells which lie dispersed in round heaps of 0.007 of a line in diameter. They contain an oil, the grease of the skin, *sebum cutaneum*, which makes the skin and hair pliable. To the glands of the hair follicles belong also, probably, Eichhorn's lymph spaces of the cutis.

c. Perspiratory glands, *organa sudoripara*, consist of a blind tube, which reaches downwards deeply into the cutis as far as the layer of fat (where it is convoluted), and opens with a spiral excretory duct, which is lined with pavement epithelium, like a funnel upon the surface of the skin. Their openings (pores) are placed in the grooves between the Papillæ. [On the ridges. TRANS.] They secrete a fluid filled with mucous corpuscles and epidermis scales. Similar in structure are the Ceruminous glands of the ear, the cells and contents of which, however, are different; their secretion contains fat vesicles.

40. II. Mucous membrane, *Membrana mucosa*.

It lines the internal cavities, since it penetrates, as the immediate continuation of the Cutis, at the external openings into the interior, passes through the whole digestive canal, and covers the respiratory organs, glands, urinary and genital organs. It is soft, like velvet, plentifully supplied with vessels and nerves, thicker or thinner, according to situation, greyish white or red, and particularly strongly developed at the external openings. It consists, like the Cutis, of Epithelium and a peculiar membrane of uniting tissue, which is connected to a muscular layer by more or less strongly developed uniting tissue (*tunica nervea*). One or more of these layers are lost as they proceed. The epithelium is thinner and more slimy (as the so-called *rete Malpighii* occupies the surface), the uniting tissue is more delicate, e. g., in the intestines, unites with the fibrous periosteum, where the mucous membrane lies upon bones (when the muscular layer is lost); or is remarkable for elastic fibres in the Trachæa and the Bronchi.

Like the external skin, it is beset with projections (folds, valves, villi, and papillæ) and depressions (sulci and fossæ).

a. The folds are for the purpose of increasing the superficies in the interior of canals and cavities, where absorption, secretion, or sensation is the object; and may, after removing the muscular coat, be drawn out (*plicæ Kerkring.* in the intestines, *columnæ rugarum* in the Vagina, &c.).

b. The papillæ are also present, especially in places which are designedly very sensitive to touch, e. g., the lips, gums, tongue, palate, labia externa, vagina.

c. The villi are present upon the mucous membrane of the small intestines only; they resemble the filamentous papillæ, but contain (instead of vascular and nervous loops), lymphatic rete, which have vascular rete spun all round them.

d. The fossæ are the openings of the mucous glandules, *folliculi mucosi*. The simple mucous glandules are not always closed follicles (*gl. solitariae* and *Peyerianæ*), over which the mucous membrane, with its villi, passes. When open, they appear to be inversions of the mucous membrane. To the class of glands with blind sacs belong the dispersed *gl. solitariae*, the amassed *gl. Peyerianæ*, *gl. Lieberkühnianæ* in the small intestines, the closed *gl. tartarica* in the gums, and the glands for secreting the gastric juice in the pylorus; to the

racemose, the glands of the lips, cheeks, tongue, œsophagus, larynx, &c., *gl. Brunnerianæ* of the small intestines, &c.

We may distinguish three separated tracks of the mucous membrane.

1. The digestive and respiratory mucous membrane commences in common at the mouth, continues into the excretory ducts of the salivary glands, upon the nose, through the lacrymal canals, and punctæ upon the fibrous coat of the eye, through the *tuba Eustachii* upon the cavity of the tympanum; it then passes on the one hand from the Pharynx through the Larynx to the Trachea and Lungs, on the other through the œsophagus to the stomach and intestines.

2. The mucous membrane of the genital and urinary organs is more separated in the female than in the male. The urinary mucous membrane, commencing from the external opening of the genitals, terminates in the excretory ducts of the kidneys, and continues in the male through those of the Prostate, into the seminal vesicles, ducts, and testicles. In the female the genital mucous membrane goes from the Vagina into the Uterus and tubes, and opens freely into the abdomen, where the serous cavity of the peritoneum communicates with it.

3. The mucous membrane of the mammary gland commences at the nipple, and terminates in the closed extremities of the milk ducts.

Division of Special Anatomy.

1. Osteology treats of the bones.
2. Arthrologia (syndesmologia), of the connection of the bones.
3. Myologia, of the muscles.
4. Splanchnologia, of the viscera and organs of the senses.
5. Angiologia, of the vessels.
6. Neurologia, of the nerves.

OF THE BONES.

OSTEOLOGIA.

"The frontispiece represents Galen contemplating the skeleton of a robber who, being killed by a traveller, had his bones picked in two days by vultures. This opportunity he mentions as a piece of good fortune, though he had seen another skeleton which was accidentally washed out of a burying place, by the overflowing of a river, besides one which was shown in a public school at Alexandria, which *he* thought was worth the trouble of any one to go on purpose to *study*."—CHESELDEN. *Osteographia*.

THE BONES.

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41.

THE BONES, *OSSA*, ὀστέα,

are hard, dry bodies, of various shapes. United into a moveable framework, which serves as a point of support to the rest of the organs of the body, they form, on the one hand, cavities for their protection, and, on the other, levers to approximate separate organs towards one another, which are set in motion by peculiar contractile organs, the muscles.

Chemical analysis resolves the osseous mass into the following constituents, abstractedly of the fat, the vessels, &c., found in bone:—

1. Cartilage, the essential, organic part of bone tissue. It consists of cells, contains cavities and tubules, and is only distinguished from permanent cartilage by the fact that the bone earth is deposited in it, and condenses it. It is obtained by macerating bone in dilute hydrochloric acid. It is soft, flexible, elastic, soluble in a warm solution of Potash, and converted into gelatin by hot water.

2. Bone earth, which is especially phosphate and carbonate of lime, with some Magnesia and Fluoride of Calcium.

The proportion of cartilage is about 0.33; of the bone earth, 0.67. The relative proportions differ, however, according to age, health, and the bones themselves.

Figure of the bones. Three forms are described:—

1. Long, or cylindrical; 2. Flat; 3. Short, or thick bones.

1. Long bones, *ossa cylindrica*, possess a large cavity, occupied by a few cells, and filled with fat and vessels. Externally they are surrounded by compact substance, and they generally serve as levers. The centre part is called body, *diaphysis*; the extremities, *apophyses*, are covered with cartilage, and are of the same construction as the short bones.

2. Short bones, consisting of a spongy mass, formed of delicate osseous laminae connected together: *subs. spongiosa*, which on the surface is closely compressed, and thus surrounded by a smooth but thin osseous layer, the cortical portion (*subs. corticalis*); as the bones of the *carpal* and *tarsal* articulations.

3. Flat bones enclose a thin layer of spongy substance, *diploe*, between two closely approximating planes of solid cortical substance. They form cavities.

42.

Texture of the Bones.

The spongy and cortical substances consist of narrow cylindrical canaliculi, medullary canals [canals of Havers], which form a network, and when they take a determinate course give a fibrous appearance to the bone. They open on one side upon the *external* surface, on the other side into the cavity of the bone or the

cell-shaped interspaces (medullary cells) of the spongy substance, and contain a loose, vascular areola tissue with numerous fat cells, the marrow of the bone, *medulla ossium*. The narrowest, from 0.005 to 0.002 of an inch in diameter, lie immediately upon the external surface of the bone. The medullary canals are surrounded by from four to twelve concentric

Osseous plates, *lamellæ*, which take a wavy course, and are perforated by short fibres, or by rectangular, narrow canaliculi, the calcigerous tubes. Between the lamellæ in the homogeneous basement tissue of the osseous cartilage, clear spots, or corpuscles having dark edges, are disposed; these are the

Bone corpuscles, *lacunæ*, oval, disc-like cavities, filled with granular matter, from which, in a stellate manner, there pass off on all sides the

Calcigerous canals, extremely delicate tubules, with numerous ramifications, in which the osseous matter or lime is found as a fine white precipitate.

Membrane of Bones. The external surface of bones is covered by Periosteum, and this again by Epithelium, in the cavities of the *nose* ciliated; but the articular extremities terminated by cartilage are uncovered, and therefore uneven. Here the medullary canals terminate in blind extremities.

Internal membrane of Bones, *Memb. Medullaris*, is nothing but the outer surface of the delicate areolar tissue which attaches the medullary matter loosely to the internal surface of the osseous tubes.

Vessels. In the periosteum a close vascular rete is placed, the fine (arterial) ramusculi of which enter the medullary canaliculi by the innumerable openings in the cortical substance, again interlace with one another, and anastomose with the vascular rete of the cavity of the bone or medullary cells. This receives its blood from larger vessels, *art. nutritiæ*, one of which enters through a large *foramen nutritium* about the middle of each (tubular) bone. The first nourish the substance of the bone; the last the medulla. The venous blood is returned partly by *venæ nutritiæ* which accompany, at least, the large *art. nutrit.* partly through peculiar canals, which are found in the diploe of the flat bones. From these canals the thin-walled, valveless veins pass out into the periosteum. They cannot be injected from the arteries.

Lymphatics are demonstrated in the medulla, but not yet, with certainty, in bone.

The existence of nerves is upheld by the sensation accompanying inflammation of the medulla. The bone substance itself is without sensation.

[The periosteum is supplied, plentifully, with nerves. TRANS.]

43. Development of bone, *Osteogenesis*.

In the embryo a solid cartilage at first appears, *cartilago formativa*, seu *ossescens*, which consists of a mass of homogeneous cells, in the centre of which are formed the medullary canaliculi, surrounded by capillary vessels. In the parietes of the canaliculi, and in the lamellæ, the lacunæ, and calcigerous canaliculi appear, and after that the deposit of lime commences, at first in the cartilaginous substance, next in the canaliculi; but it is undecided whether or not the earthy matter is chemically united with

the cartilage. Ossification commences in the cylindrical and in the flat bones which appear in pairs, from the centre spreading outwards towards the extremities and surfaces; in the azygos and short bones, vertebræ, e. g., in two or several symmetrical points, *puncta ossificationis*. It is earliest in the *clavicle*, second month of the embryo, and *jaws*, latest in the *os pisiforme*, sixth to twelfth year. Sutures arise by the meeting together of ossified parts which, as cartilage, were separated, e. g., in the skull. Many foramina and canals are in the commencement bounded by several separate pieces, e. g., *foram. magnum canal. spinalis*. The extremities of the cylindrical bones are in the cartilaginous state separate from the central portion for some time after birth, and unite at last into one bone.

Abnormal osseous development frequently appears in tendons and cartilages, in the ovary, on the sternum, on the bones much used, &c.

44. *Particular parts of the Bones.*

The skeleton is but a system of vertebræ; the bones must therefore be regarded as more or less perfect or metamorphosed vertebræ. As in these, so in other bones, we find a body and connecting parts; the former, serving generally for the attachment of muscles and ligaments, encloses cavities and passages; the latter, particularly assisting in the formation of joints.

1. Articular portions. a. Elevations, smooth, covered with cartilage:—

1. Head, *caput, capitulum*, a segment of a sphere upon a small neck (*collum*).
2. Condyle, *condylus*, semi-oval. Hereto also belongs the *processus*, process (*pr. obliquus*).

b. Depressions; smooth, covered with cartilage:—

1. *Glenoid cavity*, a smooth fossa (e. g., of the Scapula).
2. *Cotyloid cavity*, cup-like, deep, circular (e. g., of the hip bone).

2. Elevations for the attachment of muscles and ligaments:—

1. Projections, *tuber, tuberositas, protuberantia, tuberculum, zygoma, trochanter*.
2. Spine (sharp-pointed), *spina* (*spina tibiæ, ilei, processus spinosus*).
3. Crest, *crista*, broad, long.
4. Lines, *linea* (long, narrow), e. g., *linea semicircularis, l. aspera*.
5. Process, *processus*, e. g., *pr. Mastoideus, styloid, pterygoid, transversus*.
6. Branch, *ramus* (thick, long).

3. Depressions, not assisting in the formation of joints:—

1. Fossa, *fovea* (flat); the entrance wider than the floor; e. g., *f. parietalis lacrymalis*.

2. Inlet, *sinus*, a cavity with a narrow opening, e. g., *sinus Maxillaris*; cells, *cellula*, similar, but smaller.
3. Grooves, *sulcus*.
4. Incision, *incisura*, notch (on the edges).
5. Impression, *impressio*.

4. Perforations:

1. Hole, *foramen*; *hiatus* (small).
2. Fissures, *fissura* (long and narrow).
3. Canals, *canalis*, *ductus*.

45. *Conjunction of the Bones.*

I. Immoveable conjunction, *synarthrosis*. The edges of the bones rest against each other, and are joined by sutures. The edges grasping one another from opposite sides by indentations, form a true, but when merely overlying each other, a false suture.

- a. True suture, *sutura vera*.—We distinguish:
 1. *S. dentata*, where the indentations are simple, long and vertical, like teeth; e. g., the sagittal suture:
 2. *S. serrata*, when they are simple but oblique, like a saw; e. g., the coronal suture.
 3. *S. limbosa*, when the principal indentations are provided with small lateral ones; e. g., the lambdoidal suture.
- b. False suture, *sutura spuria*.
 1. *S. Squamosa*, scale suture; the rough edge of one bone overlying that of the other.
 2. *Harmonia*; the rough edges merely meeting together.

Gomphosis is that conjunction in which the teeth extend in a wedge-like manner into the cavities of the indented edge.

II. Moveable conjunction.

a. Close conjunction—*amphiarthrosis*. The bones coming immediately in contact or connected by ligaments, can only glide a little on one another, e. g., the carpal and tarsal bones. The junction at the pubes, called *symphysis*, is effected by cartilage and ligaments; the union of the hip bones, *synchondrosis*, by the interposition of cartilage alone.

b. Peculiar articular conjunction, *diarthrosis*, *articulatio*.

1. Hinge, angular joint, *ginglymus*.—Formed by two (long) bones placed at an angle, the one describing with the other an obtuse, right, or acute angle.
2. Rolling or rotatory joint, *rotatio*, s. *trochoides*.—One bone moving upon a surface lying parallel to it in a semicircle or less, e. g., radius and atlas.
3. Ball and socket joint, *enarthrosis*.—The movement is free in all directions, circular; e. g., hip joint.
4. Free joint, *arthrodia*.—The articular head is not deeply fixed in the articular cavity, as in the one above, but moves upon the articular surface; e. g., shoulder joint, thumb.

46.

I. THE HEAD, *caput*.

The twenty-two bones of the head may be divided into two classes; the bones of the cranium, of the skull, *ossa cranii*, 7, and the bones of the face, *ossa faciei*, 15.

A. Bones of the skull, *ossa cranii*.a. *The Azygos bones*, in the central line.

Os basilare, the foundation bone, consists of:

47. 1. *Os occipitalis*, the occipital bone.

Position: at the posterior, inferior part of the head, immediately above the vertebral column.

Figure: a shallow shell placed vertically, with a horizontal portion, united by a ring.

Portions: *pars occipitalis*; 2 *partt. condyloideæ*; *p. basilaris*.

Between which, *for. occ. magnum*.

Junctions: with six bones: two parietal, above; two temporal, laterally and below; one sphenoid, before; and Atlas, beneath.

a. *Pars occipitalis*, the upright shell; below, passing into the condyloid portions, is itself limited by the foramen magnum, and united above to the parietal bones, *sut. lambdoidalis*, below, to the mastoid portions of the temporal bones, *additamentum sut. lamb.*

1. The external or posterior surface; convex, presents, extending from the foramen magnum upwards, the *crista* and *spina occipitalis externa* (for the *lig. Nuchæ*); laterally, from the *crest*, the *linea semicircularis inferior* (for the *musculus rectus capitis post. maj., obliquus sup.*), and *superior* (for the *m. occipital, et trapezius*).

2. The internal, anterior surface; concave; divided into four fossæ, two superior, *fossæ cerebri*; two inferior, *fossæ cerebelli*. In the centre, the *protuberantia (spina)*, *interna seu cruciata* (for *torcula Herophili*); perpendicular; *crista interna* (for *falx cerebelli*) to the foramen magnum; horizontal: *linea transversa* (for *tentorium cerebelli*), with the *sulcus transversus* (for the *sinus transversus*).—Above the protuberance ascends the *sulcus longitudinalis superior*, generally on the right side.

b. *Partes condyloideæ*, articular portions; on either side of the *for. magnum* anteriorly.

1. Inferior surface; convex, elliptical, smooth; rests upon the *processus obliquus super.* of the Atlas. Behind, the *condylus fossa condyloidea post.*, frequently perforated by the *for. poster.* for an *emissar. Santorini*; laterally; *fossa cond. ant.* with the *foram. cond. ant.*, (for the lingual or hypoglossal nerve); externally; the *processus*, (for the *rect. capt. lateralis musc.*), and *incisura jugularis*, which forms with the petrous bone—the *for. jugulare*, the opening for the commencement of the jugular vein.

2. Superior, cerebral surface; concave; exhibits the *processus anonymus*; *foram. condyl. ant. et post.*, their internal openings; and a part of the *sulcus transversus*.

c. *Pars basilaris*, base or *cuneiform process*; azygos, in the centre before the *for. magnum*, behind the sphenoid bone and united with these.

1. Inferior surface, slightly ascending forwards, rough (for attachments of *muscul. rect. cap. ant. major et minor*), forms the bony roof of the pharynx; presents the *spina basilaris seu pharyngea* (for the *m. constrict. pharyng. superior*).

2. Superior surface, ascends obliquely forwards and upwards; smooth; forms *fossa basilaris*, for *medulla oblongata*; at the sides, narrow grooves for the *sinus petrosi inferiores*.

3. Anterior surface, joins with the sphenoid bone; the posterior sharp surface forms the anterior boundary of the *for. magn.*; the lateral borders are in contact with the petrous bone.

Borders and Angles. The two superior borders form, with the posterior of the Parietal bones, the Lambdoidal suture; instead of the obtuse angles in which they unite, in the new-born child we find the lesser fontanelle, *fonticulus triangularis*; in the place where the Occipital, Parietal, and Mastoid portion of temporal meet together the posterior lateral Fontanelle, later the *ossa Wormiana*; generally about one inch lower, the *for. mastoideum* (for *emissar. Santorini*).

Texture. The internal osseous table is very fragile, particularly thin and translucent at the inferior part in the *fossæ cerebelli*. In the condyloid and basilar portions the spongy tissue predominates.

Development. Four points of ossification; one for the shell, which appears first; two for the articular, one for the basilar portion.

Foramen magnum occipitale, the great occipital foramen, serves for the passage of the *spinal cord* with its membranes, the *vertebral* and *spinal arteries*, and the *accessory nerves of Willis*.

48. 2. *Os Sphenoideum*, sphenoid bone.

Position: in the anterior and middle part of the base of the skull.

Figure: irregular, something like a flying bat; formed of a central portion, body, with four horizontal large and small wings, and two vertical processes directed downwards.

Junction: with all the cranial bones, and with the following bones of the face: *Vomer*, *ossa zygomatica*, *palatina*, and *maxillaria superiora*.

A. Body the most central, cuboid portion, containing two cavities separated by a partition, *sinus sphenoidales*, which are closed in front by two triangular bones, *ossicula seu cornua Bertini*, and only connected by one small opening with the posterior Ethmoidal cells. The body presents 6 surfaces:

a. Superior, cerebral surface, *Sella turcica*, s. *equina*, s. *ephippium*, Turkish saddle. From before to behind:

1. A slight depression for the *Nerv. Olfactorii*.
2. A transverse groove leading to the *foramina Optica*, (for the *Chiasma* or *commissura Nerv. Optica*.)
3. A four-sided fossa, *fossa pituitaria* (for the *Hypophysis cerebri*), properly the *sella turcica*.
4. *Process. clinoides medii*, on the anterior, *posteriores*, on the posterior border of the saddle.

5. *Clinus*, the back of the posterior border of the saddle (for *Pons-Varolii*).
 β. 2 lateral surfaces, with *Sulcus Caroticus* (for the internal carotid artery); *Alæ Magnæ*.
 γ. Anterior, with *crista sphenoidal* (for the lamina perpendic. of the Ethmoid bone).
 δ. Inferior, with *rostrum sphenoidale* (for the Vomer), and commencement of the *canal. pterygopalatinus*.
 ε. Posterior, unites with *pars basilar. occipit.*—orifice of Vidian canal.
 b. Small wings, *alæ parvæ* s. *Processus ensiformes*, triangular, flat, narrow, transverse processes springing from the anterior superior surfaces of the body with two roots. Connected with *pars orbitalis ossis frontis*. Superior surface is covered by the termination of the anterior cerebral lobe. Posterior border separates the anterior lateral cranial fossa from the middle.
Processus clinoid. anter.; foramen opticum (for the optic nerve and ophthalmic artery).
Fissura orbitalis superior, the fissure between the great and small wings (for the *nerv. oculomotor, trochlearis, ophthalmicus, abducens*, and for the *Vena ophthalmica cerebralis* and *facialis*).
 c. Great wings, *alæ magnæ*, quadrangular, broad processes projecting from the sides of the body, with three surfaces and borders.

Surfaces:

1. Internal, *superficies cerebralis*, concave, forms with the temporal bone the centre fossa of the *Basis Cranii*. From before to behind we see; *foram. rotundum* (for *nerv. maxillar. sup.*), *for. ovale* (for *nerv. maxillar. inf.*); *for. spinosum*, (for *art. meningea media.*)
2. External, *superficies temporalis*, divided by a transverse crest into two portions, a superior, the temporal fossa (for the *musc. temporalis*), and an inferior, *fossa zygomatica* (for the *musc. pterygoideus externus*). On the last the inferior opening of the *foram. ovale* and *spinosum*; *Process. spinosus* s. *spina angularis* (for *m. malleus ext.*).

3. Anterior, *superf. orbitalis*, a quadrangular plate, forms the largest portion of the external wall of the orbit. The superior edge unites with the frontal bone; between the inferior border and the upper jaw—the *fissura orbital. inferior* (for *Ven. ophthalmica facialis, nerv. infra-orbital* and *subcutaneous male*).

Borders.—The three surfaces meet together in a superior broad margin, which unites with the frontal bone. The orbital and cerebral surfaces unite in a sharp, free, internal border, which assists in forming the *fissura orbital. super.* The orbital and temporal surfaces in the anterior superior which joins with the malar bone, and in the anterior inferior which, free and sharp, assists in forming the *fissura orbital. infer.* The temporal and cerebral surfaces form the posterior superior border which unites with the squamous portion of the temporal bone, and the oblique posterior inferior border which terminates with the *spina angularis* behind the *foram. spinosum*.

d. *Processus Pterygoidei*, palatine wings, descend perpendicularly from the body, one on either side, lying in the upper half free behind, and in the inferior close to the upper jaw and palate bones. Above in their root the horizontal *Canalis Vidianus*. On the anterior convex surface a furrow (*sulcus pterygoideus*), which forms, with one upon the Palate bone, the *Canal. pterygo palatinus*. The posterior surface concave bounded by two wings; *Ala externa* (for the muscle *pterygoideus externus*), *Ala interna* with a hook, *hamulus pteryg.* (for the *circumflexus palati mollis*). Between the wings, above the *ossa pteryg.*

(for the *musc. pteryg. intern.*), below the *Incisura pteryg.* (for the reception of the *processus pyramidalis* of the palate bones). Sometimes there is a *sinus pteryg.* where the *ala extern.* and *interna* meet together with the *Corpus sphenoid.*, and it is connected with the *Sinus sphenoidal.* (Mayer.)

Foramen pterygo-spinosum (seu *interruptum*, Fäsebeck) is formed by a lamella of bone, or a ligament between the *proc. spinos. alæ magnæ* and the *ala externa proc. pteryg.* (for the *ganglion oticum* of Arnold).

Texture of the Sphenoid. The compact osseous tissue predominates. The cavities in the commencement consist of spongy bone, which, by degrees, is absorbed.

Development. In the foetus the small wings and a portion of the body are separated, even up to the ninth month, from the rest of the bone (in lower animals during life, the anterior and posterior sphenoids).

Eight points of ossification. Deposit of bone first commences in the large wings from the fortieth to the forty-eighth day. The *Cornua Bertini* unite with the body of the sphenoid about the fifteenth to the eighteenth year, the basilar portion in the eighteenth to the twenty-fifth year.

49. 3. *Os Ethmoideum, s. cribriforme*, sieve bone.

Situation: in the central line of the anterior part of the base of the skull, before the sphenoid, between the frontal bones, or rather the orbital plates of the frontal bone, and behind the nasal bones.

Figure: that of a cube, consisting of thin bony plates.

Portions: 1. Central, *lamina cribrosa* with the *lamina perpendicularis*.

2. Lateral, *two labyrinthi*.

1. *Lamina cribrosa*, perforated plate, horizontal, quadrangular.

a. Superior surface, looks into the skull; from its centre a narrow, triangular process ascends perpendicularly, the *Crista Galli* (for the *falx cerebri*), with two projections on its anterior border (*process. alares*); here is the *foramen-cæcum*. On the sides and behind the *crista*, the numerous *foramina cribrosa* (for the nerves of smell); a groove on either side, *sulcus pro nerv. olfactorio*.

b. Inferior surface, the uppermost wall of the nasal cavity, which is divided into two by the vertically descending *lamina perpendicularis*. The vertical plate anteriorly lies against the nasal spine of the frontal bone and the nasal bones; behind upon the *crista sphenoidal.*, below upon the Vomer and nasal cartilage.

Borders: a. The anterior border of the cribriform plate unites with the frontal bone..

b. The posterior, with the *crista sphenoidalis*.

2. *Labyrinthus*, the lateral portions extend directly downwards from the cribriform plate, one on either side of the septum nasi, appear externally as a thin plate (*lamina papyracea*), in the orbits, internally in the nasal cavity (*lamina nasalis*). Between the two plates lie the cells (*sinus Ethmoidales*).

a. The papyraceous plate, bounded above by the frontal bone, *incisura ethmoidales* (*foramina orbitalia*); before by the lacrymal bones, below by the upper jaw, behind by the palate and sphenoid.

b. The nasal plate is divided by a horizontal fissure into a superior (posterior) shell (*concha Morgagni*), and a central (*concha media*), and larger. Both externally concave. Sometimes there are three shells or *conchæ*.

c. *Sinus seu cellulæ ethmoidales*, with a transverse septum passing through.

a. Anterior, *cell. lacrymales*, opening with the frontal sinuses, below the middle concha (*Infundibulum, meatus nasalis medius*). Larger and more numerous than

b. Posterior, *cell. palatinæ*; opening, with the sphenoidal cells, below the superior concha; they are separated from the sphenoid bone by the *Cornua Bertini*. The cells are lined with a delicate periosteum and ciliated epithelium, not mucous membrane.

From the anterior cells, on the inferior anterior border of the papyraceous plate, a hook passes off, *Process. uncinatus*, which unites with the *concha inferior*.

Conjunctions of the ethmoid with thirteen bones:—frontal, sphenoid, the inferior turbinate, upper jaw, nasal, lacrymal, palate bones, and Vomer.

Development. Ossification commences at the fifth month, first in the papyraceous plates, then in the *conchæ*; in the sixth to the twelfth month after birth, in the *Crista Galli* and *lamina perpendicularis*, the most anterior part of which, *septum mobile* of the nose, remains during life cartilaginous. The cribriform plate is first completely ossified in the second to the third year, the cells are first developed completely in the fifth to the sixth year; in the mature fœtus the external and internal lateral walls lie close to one another.

50. 4. *Os frontale, s. coronale*, forehead bone.

Situation. At the most anterior part of the skull over the face.

Shape: of a shell; the superior, larger and vaulted portion, *p. frontalis*, vertical, the inferior, *partes orbitales*, horizontal.

Conjunctions with twelve bones; two parietal, one sphenoid, one ethmoid, two nasal, two malar, two lacrymal, two superior maxillary bones.

a. *Pars frontalis*, forming the forehead, perpendicular and gently vaulted, unites at its superior border (*m. coronalis*) with the parietal bones, in the coronal suture; the inferior edge limits the horizontal part anteriorly.—Two surfaces.

1. External, convex, with the frontal suture in the first year, a frontal prominence, *tuber frontale*, the centre of ossification on either side; under this the arch of the eyebrow, *arcus superciliares* (for the *musc. corrugator superciliū*); between them the triangular smooth surface *Glabella*, and below them *margines supraorbitales*, superior border of the orbit (for the *m. orbiculares palpebrarum*), with *Incisura* or *foramen supraorbitale* (for the *nerv. art. and ven. supraorbitales*), and externally *Process. zygomaticus* (uniting with the malar bone), above *Crista frontalis*, and in continuation *linea semicircularis* (for the *musc. temporalis*).

2. Internal, concave surface; besides the elevations and depressions for the

convolutions of the brain and the Pacchionian glands, the *Sulci arteriosi* (for *Arteria meningea anterior*); in the central line: *crista frontalis interna*, the commencement of the *sulcus longitudinalis* (for *sinus long. superior*), and *foramen cæcum*, a blind, sometimes open hole (for *falx cerebri*).

Conjunctions: above with the Parietal bones, below with the great wings of the Sphenoid, laterally with the malar bones.

b. *Partes orbitales*, orbital portions, horizontal, the superior walls of the orbits, separated by the *Incisura ethmoidalis*, in which the Ethmoid lies.

1. Inferior surface, triangular, concave, in the orbit. Towards the nose; *fossa* or *spina trochlearis* (for *muscl. obliq. superior*); externally *fovea lacrymalis* (for the lacrymal gland).

2. Superior surface, convex, uneven, in the cranial cavity, supporting the inferior surface of the anterior cerebral lobes.

3. Borders. The internal forms with the annexed Ethmoid bone, *foramina ethmoidalia* (for *Nerv. Art. et Ven. ethmoid.*), and lies anteriorly upon the Lacrymal bone; the external unites with the malar bone, laterally; with the great wing of the Sphenoid, behind.

c. *Pars nasalis*, nasal portion, short, thick, immediately below the Glabella, between the orbital portions, beneath excavated in a horse-shoe shape into an *Incisura nasalis* with a projecting spine, *spina nasalis* (for the nasal bones and upper jaws), on the sides of which are the openings of the frontal cavities, *sinus frontales*.

The frontal sinuses, only completely developed after the age of puberty, lie between the two tables of the frontal portion, from the inferior margin of which they ascend to the frontal eminences; they are divided by a septum into two, sometimes several unequal spaces, and open with the anterior ethmoidal cells immediately below the middle nasal turbinate bone. They are lined with periosteum and ciliated epithelium.

Development. It begins in the second month of foetal life with two lateral centres of ossification, in the arcus superciliaris, which in the first year are associated by a suture (*sutura frontalis*), which for some years continues diminishing. It sometimes exists during the whole life. The cavities appear in the first year, and by degrees enlarge even up to old age.

b. The cranial bones occurring in pairs.

51. 5. *Ossa parietalia*, s. *bregmatis*, vertex bone.

Two quadrangular, flat, externally convex, internally concave bones; broader before than behind; united together by the sagittal suture; forming the highest part of the cranial vault; one on either side of the central line, two surfaces, four borders, four angles.

Surfaces:—

1. External, convex, smooth, vaulted in the centre, *tuber parietale*, the centre of ossification; terminal point of the greatest transverse diameter; below this the *linea semicircularis*, the concave boundary line of the *planum semicircularis*, which is above convex (for the *muscl. temp.* and *fascia temporal*).

2. Internal, concave, with elevations (*juga cerebralia*), *impressiones digitales* and *sulci arteriosi* (for the *arteria meningea media*), passing from the inferior angle. In the centre *fossa parietalis*.

Borders:—

1. The superior *margo sagittalis*, the longest, very thick, dentated; presents upon the concave surface a half groove which forms with the other half groove upon its fellow bone the *Sulcus longitudinalis*. *Foramen parietale* (*f. emissarium Santorini*).

2. The inferior, *margo squamosus*, the shortest, concave, sharpened off, unites with the squamous portion of the temporal bone (*Sut. Squamosa*).

3. The anterior, *m. coronalis*, toothed, forms with the frontal bone the coronal suture.

4. The posterior, *m. lambdoideus*, long indentations, unites with the occipital bone.

Angles: The two superior are right (*ang. frontalis* and *occipitalis*).

The anterior inferior, *ang. sphenoidalis*, pointed, long, with the *sulc. arteriosus*.

The posterior inferior, *ang. mastoideus*, obtuse, with *sulcus lateralis s. transversus* (for the transverse sinus).

The two parietal bones unite anteriorly in an extended, posteriorly in a right angle.

Conjunctions, with: *os parietale, frontis, occipitis, temporum, sphenoidium*.

Texture. On the external and internal surfaces, compact, bony tissue, between the two, diploe. The thickness of the parietal bones diminishes from above to below. In the diploe there are many veins. (Hence danger from fractures.)

Development. Ossification commences in the *tuber parietale*, at first in the twelfth week; the angles are developed the last (hence the fontanelles).

52.

6. *Ossa temporum*, temple-bones.

Situation: one on either side of the skull, below the parietal, before the occipital, behind the sphenoid, at the base and at the sides of the cranium.

Shape: irregular. Parts from behind forwards. Mastoid, squamous and petrous portions.

Conjunctions with 5: 3 cranial, 2 facial bones, parietal, occipital, sphenoid, superior and inferior maxillary bones.

1. *Pars squamosa*, scale-like, the anterior, superior, shell-formed portions of the bone, the thinnest of the whole cranium, on its outer side.

a. External surface, convex, with grooves (for *Art. temporal. profund.*), and the temporal fossa (for *mus. temp.*). *Processus zygomaticus s. ansa capitis* (for *mus. masseter*), forms the zygomatic arch with the process of the (*os mala*); between its two roots, the *cavitas glenoidalis* (the articular cavity for the head of the lower jaw); the superior, two-armed, associated with the inferior in the *tuberculum articulare* (for the *ligam. lateral. extern.*). The proper anterior articular cavity is separated from the posterior by the *fissura Glaseri* (*Chorda tympani*, *Musc. malleus externus*, *Art. et Ven. tympanica*).

b. Internal surface, at the superior part a distinct horizontal *sulcus articularis*.

c. Circumference. Three-fourths of a circle, free, above, upright; the internal border behind cut off obliquely, where it unites with the cranial bone; before united with the Sphenoid.

2. *Pars Mastoidea*, nipple-like portion behind the squamous, and deeper, separated from it above by a deep incision, *incisura parietalis*; below by the petrous portion (with the external auditory meatus). In the thickness of the bone are placed the *sinus s. cellulae mastoideae*, into which we may pass from the cavity of the tympanum. They are covered with delicate periosteum and pavement epithelium, not mucous membrane.

a. External surface, convex, rough, presents below and before the *proc. mastoideus* (for the *mus. sternocleido-mast.*, *splenius capitis*, *retrahentes auriculæ*); hence inwards, *incisura mastoideae* (for the *mus. digastricus*); still deeper and parallel a small incision (for *mus. trachelo-mastoid.*); backwards, *for. mastoideum* (for *emissarium Santorini*), and sometimes *Art. meningea posteriora*.

b. Internal surface, concave, with the broadest portion of the *fossa sigmoidea* (continuation of the *sulcus transversus*), the internal opening of the *foram. mastoideum*.

c. Circumference very thick; dentated; anteriorly, united in the pointed *Incisura parietalia* with the parietal; behind, thick and uneven, with the occipital bone.

3. *Pars Petrosa*, s. *os petrosum*, petrous bone, pyramidal, trilateral, lies obliquely from without inwards and from behind forwards, looking with the base outwards, with the apex towards the cranial cavity. Very solid, but brittle; it encloses the organ of hearing.

a. Basis, between *proc. zygomatic.* and *mastoid.* presents *Meatus auditorius externus*, the external auditory canal, behind the *cavit. glenoidalis*, oval, in the centre narrower than at its extremities (in the fœtus, instead of it, a ring, *annulus tympani*).

b. Apex, obtuse, the exit of the *Canalis caroticus* and part of the *foram. lacerum anterius*; externally, *tuba Eustachii*; above that, *canal. tensoris tympani*.

c. Surfaces. Inferior, from without to within; *Processus styloideus*, twelve to fifteen lines long, sometimes moveable, always in animals; backwards, *foramen stylo-mastoideum* (for *facial nerve* and *stylo-mastoid artery*), the inferior opening of the *Canal. Fallopia*. Inwards from the styloid process; *fossa jugularis* (for the *bulbus Ven. jugularis*); the anterior half of the *foram. jugular. s. lacerum posterius* (for the *Nervi glossopharyngeus*, *vagus et accessorius*, *ram. jugularis Nervi sympathici et Vena jugularis interna*), with the *Vallecula s. fossula petrosa* (for the *Ganglion petrosum*, *Nervi glossopharyngei*); in which the inferior opening of the *Can. tympanicus*; before the *fossa jugularis* the entrance to the *Canalis Caroticus* (for the *Carotis interna et ramus caroticus nerv. sympathici*); [from the *Carotid Canal*, *foramina* lead into the *Tympanum*.] Upon the septum, between *fossa jugularis et canal. caroticus*, the narrow entrance to the *Aquæductus Cochleæ*.

d. Anterior (internal) surface. This is the posterior wall of the central cranial fossa, with *Hiatus Canalis Fallopia* (for the *Nerv. Vidianus superficialis*) in the centre; anteriorly and externally to this the superior opening of the *canal. tympanicus*; posteriorly, *eminentia arcuata* of the superior semi-circular canal of the Labyrinth of the ear. A groove (for the *sinus petrosus*

superior) upon the upper edge, *margo petrosus*; at the apex a semilunar depression (for the *gangl. Gasseri*).

e. Posterior surface. This is the anterior wall of the posterior cranial fossa. Here, we see the *Meatus auditorius internus*; it is short, three lines long, directed obliquely forwards and outwards; at the base divided by two cross lines into four portions; in the superior anterior, *apertura intern. canal. Fallopiae* (for *nerv. facialis*); above and behind, the funnel-shaped, *fossa vestibuli superior*; below and behind, the *fossa vestib. inferior*; below and before, *fossa cochlea*; these three, with their *laminae cribrosae* (for the *nerv. acusticus* and *vasa auditoria interna*). Immediately above the *meatus* a fissure or blind foramen for the reception of the *Dura mater*; an eminence of the inferior semicircular canal of the Labyrinth; half an inch posterior, the *aquæductus vestibuli* concealed behind an osseous lamella.

f. Borders. The superior (vide d.); the inferior and internal extends from the apex to the *Incisura parietalis*, where it blends with the superior, unites with the *pars basilaris* of the *sphenoid* and with the *os occipitis*. The inferior external lies close to and unites with the great wing of the Sphenoid. The anterior and free border forms the posterior half of the *foram. lacerum anterius* (which is an interval between the Petrous, Sphenoid, and Occipital bones filled up in the fresh state with fibro-cartilage).

Canalis Fallopiae (for the *nerv. facialis*), leads from the internal auditory meatus over the Vestibule transversely outwards, turns (*geniculum*) at the *Hiatus canalis Fallopii* backwards, passes horizontally over the *fenestra ovalis* beneath the horizontal semicircular canal to the posterior wall of the tympanum, curves itself once more, and descending vertically, makes its exit at the *foram. stylomastoideum*. With the tympanum it is connected by the *canal. chord. tympani*, by the canal of the *eminentia papillaris* which, like the *canalic. mastoideus*, passes off from the vertical portion.

Canaliculus Mastoideus (for *ram. auricularis nerv. Vagi*) commences with two small openings in the fissure between the external auditory meatus and *mastoid process*, and terminates, singly, close to the *canal. chordæ tymp.* in the *canal. Fallopiae*.

Canalis tympanicus (for the *nerv. tympanicus* of the *gangl. petrosum*) runs from the *vallecula* upon the floor of the *tympanum*, continues as a groove upon the *promontory*, and again opens as a canal between *can. Fallopii* and *can. tensor tympani*, close to the *hiatus* upon the anterior surface of the Petrous bone.

Development. Five points of ossification; the first in the squamous portion in the second month of embryonic existence; the second in the pyramid; the third is the ring around the tympanum, *annulus tympani*, which in many animals continues as a distinct bone during life, in the embryo lies at the commencement almost horizontally, and is open above; the fourth in the mastoid portion; the fifth in the Styloid process. The zygoma, at birth, is little, the external auditory canal not all developed, the articular cavity therefore almost flat; the mastoid process also is not developed until late; the Labyrinth and ossicula auditus are completely formed.

53.

Of the Cranium in general.

By the union of the seven bones, now described, with one another by means of peculiar sutures, a tolerably closed shell is formed of an egg shape above, but somewhat flattened below and upon the sides. In it the Brain is contained.

54.

1. Sutures, *Suturæ Cranii*.

In a newly born infant a suture passes in the central line of the skull from the superior angle of the occipital, to the root of the nose on the frontal bone. This is

1. The Sagittal, *s. sagittalis*, between the Parietal bones, with which in the adult,

2. The frontal, *s. frontalis*, unites.—This long suture is anteriorly, upon the crown of the head, crossed by a transverse suture, the

3. Coronal, *s. coronales*, which unites the parietal with the frontal bones, and is behind bounded by the

4. Occipital, *s. lambdoidea*, which joins the parietal and occipital bones together. To this last is added the almost rectangular

5. Mastoid suture [*additamentum suturæ lambdoidalis*], uniting the Occipital and Parietal bone, a portion of it, with the mastoid portion of the temporal. From this (from the *Incisura parietalis*), anteriorly, proceeds the arched

6. Squamous, *s. squamosa*, between the parietal and squamous portion of the temporal bone. Lastly, below the frontal bone an irregular transverse suture passes, the

7. Transverse, *s. transversa*, connecting together the cranial and facial bones.

These sutures, which unite the edges of those portions of the bones which become ossified at a later period, continue incomplete even for some time after birth, and therefore present at the angles, where most of the borders meet together, unossified intervals, which are not completely closed until the fourth year, the

55.

2. Fontanelles, *fonticuli*.

In the middle line of the skull:—

1. *Fonticulus Major*, the large quadrangular fontanelle between the superior angles of the Frontal and Parietal bones.

2. *Fonticul. Minor*, the smaller fontanelle, triangular, with the base directed towards the occipital; the apex towards the parietal bones, where the Lambdoidal impinges upon the Sagittal suture.

On either side of the skull lies a fontanelle, *fontic. lateral*, above and behind the mastoid process of the temporal bone, in that place where at a later period the parietal meets with the temporal and occipital bones. In this place we frequently meet with the so-called Wormian bones, *ossa triquetra*; the number, size, and position of which are never constant; they must be regarded as isolated, unessential points of ossification. Sometimes a triangular bone is found at the superior angle of the lambdoidal suture, representing even the apex of the occipital bone itself.

56.

3. Form and Measurement.

The shape varies with the Diameter of the skull, both according to age, sex, and varieties in the Race.

1. *Longitudinal Diameter*; from the *for. cæcum* to the *occipital protuberance* = 5 inches.

2. *Transverse Diameter* between the bases of the two petrous bones = $4\frac{1}{2}$ inches.

3. *Vertical Diameter* from the anterior border of the *for. magnum* to the centre of the *s. sagittalis* = $3\frac{1}{4}$ inches.

The circumference is in children proportionably greater than in adults; in the male sex and in the Caucasian Race larger than in the female and other Races.

The circumference of the skull stands in an inverse relation with that of the face. Vide the facial angle of Camper.

57. 4. The Cranial cavity, *cavum cranii*.

a. Basis; rests upon the Atlas; contains three terrace-like gently descending fossæ, *fossæ cranii*.

1. Anterior, most elevated, but the smallest, supports the anterior cerebral lobes, is formed of:—

Ethmoid, Frontal, and the lesser wings of the Sphenoid bone:

Presents, anteriorly, *for. cæcum*, *Crista Galli*, and *c. frontalis interna* (for *Falx cerebri*).

In the centre, *foramina cribrosa* (for olfactory nerves): posteriorly, *for. Optica* (for *Optic nerve* and *Ophthalmic artery*); *Proc. clinoid. anter.*

The sharp posterior border, before the *fossa Sylvii* and *sinus Ophthalmicus*.

2. Central, supporting the middle cerebral lobes and base of the great brain, formed by the greater wings and the body of the sphenoid, by the squamous and the petrous portions of the temporal bones: posterior limit: *Anguli Petrosi* and the posterior edge of the *Sella Turcica*;

Presents, in the centre, the *Sella turcica* (for the *Hypophysis*, [pituitary gland], *Infundibulum*, circular sinus of Ridley: with, *proc. clinoid. medii* (for the commissure of the *Optic nerve*); *proc. clinoid. poster.* (for the *corpora mammillaria*); next the *sulcus caroticus* (*sinus cavernos.*, *carotis*); *for. lacerum anterius*.

At the sides, anteriorly, *Fissura orbitale superius* (for *nerv. oculomotor*, *trochlearis*, *ram. ophthalmic. n. trigemini*, *n. abducens*, *ven. ophthalmica*).

Farther backwards, *for. rotundum* (for *nerv. maxillar. superior*).

Externally, *for. ovale* (for *n. maxillar. inferior*);

for. spinosum (for *art. meningea med.*); and

hiatus canal. Fallopiæ, and *for. tympanicum*.

3. Posterior, the lowest, but largest (for the *cerebellum* and *Medull. Oblongata*).

Formed, by the Petrous and Mastoid portions of the Temporal bones and by the *Os occipitis*;

Bounded, before by the *anguli petrosi*, behind by the *sulcus transversus*; presents in the middle line, anteriorly, *fossa basilaris* (for *Pons Varolii*, *medulla oblongata*); has therein, *foram. magnum* (for *Spinal cord* and *n. access. Willistii*, the *art. spinal.* and *vertebral*), *foram. condyloidea anteriora* (for *nerv. Hypogloss.*);

Posteriorly, *spina* and *crista occipit. int.* (for *Falx cerebelli*, *torcula Herophili*);

At the sides, anteriorly, *for. jugulare* (for the *nerv. glosso-pharyng. vagus*, *accessorius Will.*, and *vena jugularis*), with the termination of the *sulc. transversus* (for *sinus transversus*);

More externally and above, *meatus auditorius intern.* (for *nerv. facialis* and *acusticus*, and *Aquæduct. Vestibuli*);

Lastly; *lineæ transversæ* (for *tentorium Cerebelli*), with *sulcus transversus*.

b. The Cranial arch, *fornix*, the smooth roof above the convex surface of the brain; formed of frontal, parietal, and occipital bones.

Presents, in the central line, *Salcus longitudinalis* (for the longitudinal sinus), extending from the *Spina frontalis interna* to the *Eminentia cruciata*. On the sides the *sulci arteriosi* and *cerebral impressions*. Here, as upon the external surface, the sutures, already mentioned, may be seen. The brittle, hard, bony tissue on the internal surface of the *fornix* is called the *vitreous table*, *lamina vitrea*.

4. External surface of the skull; it is covered with *pericranium* (periosteum); presents (the sutures, ut sup.). Besides these:

a. Vault; *linea semicircularis*, one upon either side, from the central frontal eminence to the *spina occipital. externa*.

Tubera frontalia, parietalia.

b. On the basis:

1. Anterior half: *Pars nasalis, process. orbitales, occipitales*;

2. Posterior half: *Spina* and *Crista occipit. extern.*, *Proc. condyloid.*, *Pars basilaris*. *Lin. semicircular. inferior*, *Occiput*, *Fossa condyloid. poster.*, *Foramen lacerum posterius s. jugulare*; *Foramen lacerum anterius*, with *Sulcus carotic.* and *Tuba Eustachii*, to which point all the sutures of the posterior half of the basis *Cranii* proceed.

More externally and posteriorly: *Proc. mastoid.*, *Proc. styloid.*, *For. stylo-mastoid.*, and the inferior opening of the *Canalis caroticus*.

c. At the sides: the mastoid region, *foram. mastoid.*, *meatus auditor. extern.*, *cavitas glenoidea*, root of the *Proc. zygomatic.*, *os temp.*

Fossa temporalis, temporal fossa, is the name given to the space between the lateral part of the skull and the zygoma, which below passes into the zygomatic fossa, is occupied by the *temporal* muscle and formed by the temporal bone, *ala magna* of sphenoid, malar, superior maxillary, and frontal bones, and bounded below by the zygomatic arch; above, by the *lin. semicircularis*.

58. B. *Ossa faciei*, Bones of the face, 14.

a. Those occurring in pairs.

59. 1. *Ossa maxillæ superioris*, 2. Upper jaw-bones.

Position: anteriorly in the face, below the orbits.

Shape: irregular, almost cubical, short; Body with 4 processes.

Conjunctions with: Frontal, Ethmoid, and Sphenoid bones, and with all the bones of the face except the lower jaw.

1. Body, hollow, bounded by four surfaces.

a. Anterior, facial surface, *planum faciale*, is bounded above by: *Margo infraorbitalis*, the inferior border of the orbit, for *m. orbicul. palpebrarum* and *levator labii superioris*; underneath this, *foramen infraorbitale* for *nerv. art.* and *ven. infraorbitale*; within this the *ant. alveolar foramen* for *ant. dental nerve*; and *fovea maxillaris s. caninus*, for *m. lev. anguli oris*.

b. Posterior, temporal surface, arched, with: *Tuber maxillare*; *foram. alveolar. poster.*, leading to a canal running along the floor of the antrum, for *nerv. art.* and *ven. alv. post.*

c. Superior; orbital surface triangular, with: *Sulcus* and *canalis infraorbitalis*, for *nerv. art.* and *ven. infraorbitalis*, which opens upon the facial sur-

face; *margo externus, posterior*, free; between it and the larger wings of the sphenoid bone—*fissura orb. inferior*.

d. Internal, nasal surface, with the opening of the *antrum Highmori*, before it *Crista turbinalis inferior*, for the inferior concha in the formation of the lacrymal canal; *sulcus pterygo-palat.*, helping to form *canal. ptery-pal.*, at the posterior part.

Sinus maxillaris s. *antrum Highmori*, pyramid-shaped, with very thin superior, orbital, and inferior walls, particularly over the sockets of the Canine and first Bicuspid teeth, connected with the *sin. pterygoid.* and *jugal*. Its irregular opening contracted by the inferior nasal concha, Palate and Ethmoid bones to a small foramen opening beneath the inferior turbinate bone. It is lined with a delicate periosteum and ciliated epithelium, not mucous membrane. (Henle.)

2. Processes: a. *Proc. nasalis* s. *frontalis*, internal, superior process, with an external surface, for *m. levator lab. super. alaeque nasi*; and an internal, concave, on which are *lineæ turbinatæ* s. *transversæ*, for the middle and inferior nasal concha; farther, the anterior border unites with the nasal bone, the posterior thick border with a groove, *sulcus lacrymalis*, which continues into the *Canal. lacrymal*. The apex lies in the fissure of the frontal bone.

b. *Proc. zygomaticus*, external superior process unites with the malar bone.

c. *Proc. alveolaris*, the process for the sockets of the teeth, that is, the inferior thick border of the upper jaw, contains eight cells for teeth, *alveoli*, with projections and depressions; at the point of union of the two upper jaws, *Spina nasalis anterior*; behind that, the *Canalis incisivus*, for the *nerv. nasopalatin*. *Scarpa*, and *arteria sphenopalatin.*, leads from the nasal into the buccal cavity; the *foram. incisivum* is sometimes double.

d. *Proc. palatinus*, palate process; this, the horizontal roof of the mouth and the floor of the nose, unites internally with the palate process of the other side, behind with the horizontal portion of the palate bone; thence arise the *sutura palatina* and *cruciata*, and *Crista nasalis*, for the *Vomer* upon the upper surface.

Tissue of the upper jaw. Spongy substance is only present in the alveolar and malar processes. The entire bone is very light.

Development. The first point of ossification appears from the 35th to the 55th day of embryonic existence in the alveolar process. A centre of ossification is probably found in the position of the intermaxillary bone of mammalia, *Os incisivum* (Hare lip an arrest of the development of this bone); likewise one for *canalis infra-orbitalis*.

At birth the upper jaw is very small; nevertheless the antrum of Highmore is already present.

60.

2. *Ossa Palatina*, Palate bones, 2.

Situation, at the posterior part of the nasal cavity, and behind the palate processes of the upper jaw, before, and in, the *Pterygoid processes* of the Sphenoid.

Figure: a right angle, consisting of a horizontal palate portion, and a narrow vertical plate.

Conjunctions: with one another and with the upper jaws, the sphenoid bone, the inf. Turbinate and the Vomer.

1. *Pars horizontalis*; a. Superior surface, which forms the floor of the nasal cavity, with the *Crista nasalis* for the Vomer.

b. Inferior surface, which forms the buccal cavity; hard palate, with *spina nasalis posterior*, for *m. levatores uvulae*. The internal border forms the *sutura Palatina*, the anterior, *sut. cruciata*.

2. *Pars ascendens*, thin, quadrilateral, longer and broader than the plate before described, from the external border of which it ascends on the nasal wall of the upper jaw, even to the orbit.

1. Internal surface presents, the *linea transvers. s. crista turbinalis media* and *inferior*, for the inferior and middle turbinate bones.

2. External surface lies anteriorly on the *upper jaw*, behind on the *pterygoid process*; presents *Sulcus palatinus*, a part of the *Canal. pterygo-palatinus*, for *art. and nerv.*

3. Processes: a. *Proc. pyramidalis*, triangular, external and posterior, lies in the *incisura pterygoid.* of the Sphenoid. On it two canals; *Can. palatinus extern.* and *intern.* between *fossa speno-maxillar.* and palate, for *nerv. and art. palatin.*—Above:

b. *Proc. orbitalis*; triangular, looks with its *superior* surface into the orbit, lies with the *external*, behind on the upper jaw, with the *internal* on the papyraceous plate of the Ethmoid. Behind it, inclining backwards:

c. *Proc. sphenoidalis*, to the Body and the cornua of the sphenoid.

Between the processes *b* and *c*, and the *body* of the sphenoid, the *Foram. sphenopalatinum*, for the *nervi nasales, art. et ven. speno-palatina*, leads from the *fossa speno-maxillar* into the nose.

Development. The first osseous nucleus appears about the 40th to the 50th day at the point of junction of the processes. The orbital process is yet wanting at birth.

61. 3. *Ossa Malaria s. jugalia, s. zygomatica, Malar,* Cheek bones, 2.

Situation: at the superior lateral parts of the face, externally upon the upper jaws.

Shape: an irregular quadrangle, consisting of a body and three processes.

Conjunctions with: Frontal, sphenoid, sup. maxillary and temporal bones.

1. Body, with 3 surfaces and 3 borders; contains sometimes a cavity, the size of a bean, *sinus jugalis* (Mayer), especially in Mongolians and Malays, which is connected with the *Antrum of Highmore*.

a. External, facial surface, convex, for *mus. orbicularis palpebrarum, zygomaticus major et minor*; it presents *foramen zygomatic. anterius*, sometimes several; this is the commencement of the *canal. zygomat. anter.*

b. Internal, orbital surface; this is the anterior part of the orbit; externally

it presents, *for. zygomatic. anter.*, which is the end of the *Canal. zygomatic. anter.*, for the *n. subcutaneous malæ*; a groove leading to *for. zygomatic. poster.*, the commencement of the *Canal. zygomatic. poster.*

c. Posterior, temporal surface, hollowed out for *muscul. temporalis*, presents the end of the *canal. zygomatic. poster.*, namely, the *for. zygomatic. poster.* for the *n. zygomaticus s. temporalis*.

2. Processes:

a. *Pr. frontalis*, the superior, unites with the Frontal, and behind with the Sphenoid bone.

b. *Pr. temporalis*, unites with the process of the temporal bone to form the zygomatic arch *arcus zygomaticus*, for the *muscul. masseter*.

c. *Pr. maxillaris*, triangular, broad, and little projecting, unites with the *Pr. zygomatic.* of the upper jaw.

Formation. The malar bone consists almost entirely of compact bony tissue; spongy tissue is only found at the anterior inferior border.

Development begins early from one central point about the 50th day of foetal life. At birth the orbital margin is sharp, and it is not rounded until later.

62. 3. *Ossa Nasalia*, Nasal bones, 2

Situation: next to one another, sometimes united, beneath the frontal, between the two nasal processes of the sup. maxillary bones; oblique from above and behind, to below and before.

Shape: a long quadrangle, above, narrow and thick, below, broad and thin.

Conjunctions: with Frontal, Superior Maxillary, Ethmoid bones and Nasal cartilages.

1. External, cutaneous surface, covered by the *muscul. pyramidalis nasi*, flat, somewhat convex, with a large, and several smaller foramina for the *Vasa nutritia*.

2. Internal surface, the anterior portion of the nasal cavity, presents grooves for vessels and nerves, the *nerv. Ethmoidalis*.

3. Borders. a. Superior, fitting into the *incisura nasalis* of the Frontal bone.

b. Inferior, supporting the lateral cartilages of the nose, between them a foramen for a nerve filament and arterial twig, *nerv. Ethmoidalis*.

c. Internal, forms with the bone of the other side the *crista nasalis*, for the *lamina perpendicularis* of the Ethmoid, and above for the *spina nasalis*, of the Frontal bone.

d. External, longer than the last described, unites with the nasal process of the upper jaw bone.

Development: from one osseous centre, commencing at the end of the 2d month of foetal life. The nasal bones are completely formed at birth, but not the cartilages.

63.

4. *Ossa lacrymalia s. unguis*,

Lacrymal bones, 2.

Situation: at the anterior part of the nasal wall of the orbit, between the nasal process and the orbital surface of the superior maxillary before the os planum of the Ethmoid, beneath the frontal bone.

Shape: quadrangular, flat, small, like a finger-nail; translucent, thin.

Conjunctions: with the Superior Maxillary, the Ethmoid, Frontal and Inferior Turbinate bones.

1. External, orbital surface, divided by the *crista lacrymalis* with the *hamulus lacrymalis*, into an *anterior* grooved half, which forms a part of the *fossa lacrymalis* with the groove on the *proc. nasalis* of the superior maxilla, and a posterior half.

2. Internal surface, presents a groove which forms a portion of the middle nasal chamber; and covers behind the *cellulæ ethmoidales anteriores*.

Structure. The most brittle of the bones; consisting of compact substance.

Development. One osseous centre at the 4th month. At birth most completely formed.

64.

5. *Ossa Turbinata s. Conchæ inferiores*,

Inferior Turbinate bones, 2.

Situation: at the lowest part, on the external wall of the nasal cavity, beneath the Ethmoid bone.

Figure: twisted, shell-like. More pointed behind than before.

Conjunctions: with the Superior Maxillary, Palate, Ethmoid and Lacrymal bones.

1. Internal surface, convex, looks towards the septum of the nasal cavity, and sometimes touches it.

2. External surface, concave, looks towards the Superior Maxillary bone, and forms a portion of the inferior nasal chamber.

3. Borders: a. The superior, unites with the nasal process of the Sup. Maxillary bone; behind with the Palate bone. It presents from before to behind.

1. *Proc. lacrymalis*, united at the apex with the Lacrymal, at the sides with the upper jaw bone; forms, with the *proc. nasal.* of the Sup. Maxillary bone, the *can. lacrymalis*.

2. *Proc. Maxillaris s. auricularis*, hooked, contracts the opening of the *Antrum Highmori*, to the inferior border of which it is attached. Behind this a small border, for the Palate bone.

3. *Proc. Ethmoidalis*, unites with the *Proc. uncinnatus* of the Ethmoid.

b. The Inferior free border, in the centre thicker than at the extremities, is more or less distant from the nasal septum.

Structure: compact bony tissue, but porous; many canals for nerves and veins.

Development: one ossific nucleus in the centre, about the 5th month after birth.

65. b. Azygos Bones of the Face.

6. Vomer, Ploughshare bone.

Situation: in the centre of the nasal cavity, forming the posterior part of the septum.

Figure: flat, angular. Portions: 2 surfaces, 4 borders.

Conjunctions with: Sphenoid, Ethmoid, both Superior Maxillary and Palate bones, and the cartilage of the nasal septum.

1. Surfaces, with small grooves for vessels and nerves, covered with mucous membrane.

2. Borders: a. Superior, *margo sphenoidalis*, short, thick, with a deep groove and two lips, *ala vomeris*, for the reception of the *rostrum sphenoidale*.

b. Inferior, *palatinus, maxillary*, the longest, unites with the *crista nasalis* of Sup. Maxillary and Palate bones.

c. Anterior, *m. ethmoidalis*, unites with the *lamina perpendic.* of the Ethmoid, below with the cartilage.

d. Posterior, *m. gutturalis*, free, thin, sharp, inclining from above and behind to below and before, separates the posterior openings of the nasal cavity, *choanae*.

Structure: the Vomer consists of 2 very thin plates of compact bone, the upper separated more than the lower.

Development: begins below, with the 3d month of fœtal life, and is only completed in the 12th year. Ossification proceeds from without inwards, so that for a long time a groove exists between both plates for the reception of the Sphenoid and Ethmoid bones.

66. 7. Maxilla inferior, Mandibula, Inferior, lower or under jaw.

Situation: at the inferior region of the face.

Shape: of a horse-shoe, parabolic.

Portions: a central horizontal *body*; 2 lateral vertical ascending *rami*.

Conjunction: with the temporal bones.

1. Body, curved like an arch, consists originally of two pieces of bone which unite anteriorly in the central line, to form an arch, the chin, *mentum, γένειον*.

NOTE. In many animals a *suture* exists in this place; in Serpents a *moveable* articulation. The chin of animals never forms an *arch*, but always an *angle*.

a. External surface, presents: *Spina mentalis externa*. To the outer side of this *foramen mentale*, which is the exit from the *Canal. alveolaris*, for *Nerv. Art. et Ven. alveol. inferior*.

b. Internal surface, presents: in the centre, *Spina mentalis interna*, on either side *processus geni*, four tubercles, sometimes surfaces, the two *superior* for the *genio glossi*, the two *inferior* for the *Genio-Hyoidei* muscles, and a ridge the *Mylo-hyoid* for the *mylo-hyoideus* muscle; above this a superficial fossa corresponding to the *Sublingual*, and one below to the *Submaxillary gland*. In the centre also a nutritious foramen.

c. Superior border, *limbus alveolaris inferior*, behind, thicker than before, presents: sixteen sockets, *alveoli*, for sixteen teeth with elevations, *Juga alveolaria*, for the *levator menti* and *incisivi* muscles.

d. Inferior border, *base*, thick with an anterior lip for the *musculi triangularis, quadratus menti et platysmamyoideus*, and two posterior surfaces for the anterior bellies of the *m. digastricus*.

2. Rami, ascend at a right angle, in the adult, *angulus maxill. infer.*, from the body, and terminate in the temporal fossa by two processes.

a. Surfaces. 1. External, flat, rough, for *musculi masseter*, anterior to which, sometimes, a very slight groove, for *art. facialis*. 2. Internal, also rough, for *m. Pterygoid. intern.*, with *foram. maxillar. poster.*, for *inferior maxillary* or *dental nerve*. To the borders of the foramen is attached the *lig. lateral. intern.*, and close to it is the *Sulcus mylohyoideus*, for the *nerv. mylohyoid*.

b. Borders: posterior, for *Parotid*, and below for attachment of *Stylo maxillary ligament*. Anterior, grooved; the ridge or continuation of the *linea obliq. extern. et intern.*

c. Processes:

1. Anterior, *Proc. coronoideus*, triangular, the apex free, for *musculi Temporalis*.

2. Posterior, *Proc. condyloideus*, articular process, unites in the *Glenoid cavity* with the *os Temporum*. It presents the neck, *Collum Condyli* and the *fossa* for the *musculi Pterygoid. extern.* Between the two processes: *Incisura semilunaris seu sigmoidea*, for nerves and vessels.

Structure. Compact, bony tissue, on the surfaces, in the interior *Diplöe*. The canal for the nerves and vessels of the teeth follows the *linea obliq. interna*, communicates in this course by one foramen, two, with the alveoli, divides in the region of the *Bicuspid* teeth into two short canals, one of which opens at the *foram. mentale*, the other passes as far forwards as the first *incisor* tooth. Lying at the inferior border, before the appearance of the teeth, they are associated together, and the *canal. alv. inf.* always moves upwards as age advances, or, rather bone is developed beneath it, and thus it appears to ascend.

Development. Next to the *clavicle* the earliest perfectly formed bone; in *mammals*, it presents even in the 2d month one osseous centre upon either side for the body. Soon after birth the two halves unite together. In the new-born infant the lower jaw is very small, the *angle* still obtuse, the alveolar processes broad. In old age the alveolar processes disappearing after the teeth have fallen out, the lower jaw becomes smooth, thick, and again small.

67. Appendage. *Os Hyoïdeum, s. linguale*, tongue bone.

Position: free in the neck, above and before, between the tongue and the larynx, horizontal.

Shape; a Parabola like the Greek letter upsilon υ .

Conjunctions; by ligaments with the temporal bones and the thyroid cartilage. Parts: 1 body, 4 cornua.

1. Body, *basis*, the horizontal, anteriorly convex, central portion, is upon the bones of animals, into a superior and inferior half.

b. Posterior surface, excavated, concave, separated by fibrous tissue from the epiglottis.

c. Inferior border, for *mus. Hyo-thyreoides*.

d. Superior border, for *ligam. suspensor. linguae* and *lig. flavum s. hyo-thyreoides*.

Terminations, covered with cartilage, for the reception of the great Cornua.

Attachment of muscles; to the *Transverse lines*, *Mylo-hyoideus*, above that *genio-hyoideus*; to the *Superior half*: *digastricus*, *hyoglossus*, *stylo-hyoideus*; to the *inferior half*: *sterno-hyoideus*, *omo-hyoideus*, and the *thyreo-hyoideus*.

2. *Great Cornua*, longer than the body, ascend from before backwards and upwards, for *Kerato- (Hyo-) glossus*, *Kerato-pharyngeus* (part of middle constrictor); *capitulum*, for *ligam. hyothyreoides laterale*, at the apex.

3. *Lesser Cornua*, or *corpuscula triticea*, like a grain of wheat, situated obliquely upwards and outwards at the point of junction of the great Cornua with the Body, for the *mus. Chondro-glossus* (part of *Hyo-glossus*) and *Chondro-pharyngeus* (a portion of *Constrictor Med.*); unites with the *Proc. Styloideus* by the *ligam. suspensorium*, sometimes ossified; it is connected with the great cornua and the body.

Development: proceeds slowly from five ossific points, from the termination of foetal life; it commences in the great cornua.

The Cavities of the Facial region.

68. 1. *Orbitæ*. Orbital cavities, 2.; for the organs of sight and lacrymation.

Figure: an obtuse, quadrilateral pyramid, the base directed forwards and outwards, the apex backwards and inwards; the axes of both would cross *behind the sella turcica*.

1. *Base*, formed by four borders, with four angles, Frontal, Nasal, Temporal, Malar.

a. *Margo supraorbitalis*, with *foram.* sometimes *Sulcus supraorb.*, formed by Frontal bone;

b. *M. orbitalis externus*, with *foram. zygomatic.*, by malar bone, and malar or external angular process of frontal;

c. *M. infraorbitalis*, with *for. infraorbitale* and anterior dental foramen, by the malar and sup. Maxillary bones;

d. *M. orbitalis internus*, by *nasal process of super. Maxillary* and *internal angular process of Frontal bone*; immediately behind is the little *Lacrymal bone*. The circumference is narrower than the cavity behind it.

2. The Walls, covered with periosteum, *Periorbita*, formed of seven bones.

a. Superior, the roof, formed before by the frontal, behind by the lesser wing of the Sphenoid bone, presents: an external angle, *fovea lacrymal.*, for the *lacrymal gland*; an internal, *fovea*, s. *Spina Trochlearis*, for the tendon of the *m. obliq. superior*; posteriorly, the suture between the Frontal and Sphenoid bones.

b. Inferior, floor, inclined *outwards* and *downwards*, formed by *marg. orbitale* of the malar, *facies orbit.* of the upper jaw, and behind by the *Proc. orbital.* of the Palate bone; with, *Canal. infraorbitalis*; bounded externally by the *fissur. orbital. inferior*.

c. External wall, formed by the great wing of the Sphenoid and the Malar bones, with: *Fissura orbitale inferior* below, *fissura orbit. superior* behind, and an oblique groove upon the malar bone leading to the *superior or posterior malar canal*, for the temporal twigs of the nerve.

d. Internal, formed by Lacrymal, Ethmoid, and the small wing of the Sphenoid bone. On this wall there are two vertical sutures; *Fossa lacrymalis*, and entrance to the *Canalis lacrymalis*, *Foram. Ethmoidalia*, *Spina* s. *fovea Trochlearis*, for the cartilaginous loop through which the tendon of the *m. obliq. superior* passes.

3. Apex, above, and internal, *foramen opticum*; below, the *Fissura supra* and *infra orbitalis* and *fossa Spheno-maxillaris* meet together.

Connected with: 1. The cranial cavity, by the *foram. opticum*, *Fissur. orbital. superior* and *foram. ethmoid. post.*

2. The nasal cavity, by the *foram. ethmoidalis ant.* and *canalis lacrymalis*.

3. The Temporal and Pterygo-palatine fossa by the *fissur. orbital. inferior* and *canalis zygomat. superior* s. *posterior*.

69.

2. *Cavitas nasi*, nasal cavity,

consists of two principal cavities lying close together, and separated by a septum or partition, situated between and below the two orbits, and bounded above by the horizontal plate of the ethmoid; below, by the united superior maxillary and palate bones, open before and behind, and covered with a mucous membrane, *Membr. Schneideri*. It is formed of fourteen bones.

1. Anterior opening, pear-shaped, *Apertura pyriformis*, formed by the superior maxillary, and nasal bones, which have attached to them the lateral nasal cartilages.

2. Posterior opening, *Choanæ narium*, quadrangular, rather longer than broad, divided by the Vomer; formed, laterally, by the *Pterygoid processes*; above by the Sphenoid and Palate bones; below by the Palate bones; looks towards the Pharynx.

3. Central division, *septum narium*, formed by the *vertical plate* of the *Ethmoid*, by the *Vomer*, *crista nasalis* of the *Frontal*, *crista* of the *Nasal*, *Sup.*

maxillary, and *Palate* bones, with the continuation of the cartilaginous *septum Mobile*; is generally curved or twisted; forms the internal wall.

4. Walls: a. superior, concave, formed by the Nasal bones, the nasal spine of the *os frontis*, by the Ethmoid, with *foramina Cribrosa*, in the centre; by the Sphenoid behind.

b. Inferior wall, broader, not so long, posteriorly deeper; formed by the *Proc. palatin.* of the *Sup. Max.*, and the horizontal portion of the *Palate* bones; presents, *canal. incisivus*.

c. External wall, very irregular, formed by: Ethmoid, Lacrymal, *Palate*, *Sup. Maxillary* and the *Inf. Turbinate* bones; presents from above to below.

1. The superior Turbinate bone or *Concha*;

2. The superior nasal chamber, and on its posterior part the

3. *Foramen speno-palatinum*, and the openings of the superior Ethmoidal and Sphenoidal cells.

4. The middle Turbinate bone or *Concha*, and middle chamber with the opening of the *sin. maxillaris*, and the anterior Ethmoidal and frontal cells.

5. The inferior Turbinate bone and the inferior chamber, with the opening

6. of the *Canalis Nasalis*.

Connection: with the Frontal, Ethmoid, Sphenoid, Superior Maxillary, Orbital, Buccal, and Cranial cavities; the last by the *foramina Cribrosa*.

70. 3. *Cavitas oris*; Buccal cavity, mouth,

formed by the Superior Maxillary, and *Palate* bones, the Sphenoid and *Inf. Maxillary*; contains the tongue, teeth, glands, and buccal mucous membrane.

1. Superior wall, palatal vault, *palatum durum*; formed by: the *Sup. Maxillary* bones, *proc. palatini*, the *Palate* bones, *proc. horizontal*; and Sphenoid, *proc. Pterygoid*; presents: *sutura cruciata*, with the point, where 5 bones meet together, namely, 2 Superior Maxillary, 2 *Palate* bones, 1 Vomer; *foramen Incisivum*; the openings of the *can. pterygo-palatinus* and the 2 *Palatini*; *Sulcus Palatinus* close to the alveolar border, for the *posterior palatine nerves and vessels*.

2. Anterior and lateral walls; formed by: the *Alveolar processes* with the *teeth* of the jaw bones; presents: on lower jaw, *Spina mentalis interna*, *proc. geni*, for *mus. genio-hyoidei* and *genio glossi*; *linea obliqua*, or *mylo-hyoidea*, under this, the *fovea pro gland. submaxill.*, over it, *fovea pro gland. sublingual.*; *sulcus mylo-hyoideus* and *foram. maxillare internum*.

Connections: with the nasal canal by the *can. incisivus*, with *fossa speno-maxillaris* by *canales palatini*.

71. 4. Malar fossa, *fossa zygomatica*.

Situation: below the zygomatic arch, separated from the *fossa temporalis* by the *crista transversa* of the Sphenoid bone.

Formed by: Sphenoid, Superior and inferior maxillary bones.

1. Superior wall, formed by the inferior surface of the *Ala Magna* of the Sphenoid bone.

2. Anterior, by the *tuber maxillar. sup.*
3. Internal, by the *ala extern. proc. pterygoid.*
4. External, by the *ram. maxillaris inferior.*
5. Posterior and inferior walls are deficient.

On either side, in the depth between the *Superior maxillary, pars perpendicular*, of the *palate* and *proc. pterygoideus* of the Sphenoid bone, belonging to the above described fossa, is situated, the

**72. *Fossa Spheno-maxillaris s. pterygo-palatina,*
the Pterygo-palatine fossa.**

Position: *behind* the Orbital, *beneath* the Cranial, *above* the Buccal, *close* to the Nasal cavities; *internal* to the *fossa zygomatica*. Contains: *arteria maxillaris interna*, and the 2d division of the 5th nerve, and *Meckel's Ganglion*. Five foramina lead to this fossa;

- a. Above and behind: *foram. rotunda Vidianum, pterygo-palatinum*;
- b. Internally; *foram. spheno-palatinum*;
- c. Below; the superior opening of the *Can. palatin. post.*

Connection with: the orbit, by *fissur. orb. infer.*; the nose, by *for. spheno-palat.*; the mouth, by *canal. pterygo-palat. and palatini*; the cranial cavity, by *foram. rotund. and Vidianum*.

73. Facial angle.

Angulus facialis Camperi is formed, by drawing a perpendicular line from the *inferior Incisor teeth*, in the middle line, to the most prominent portion of the *Frontal bone*, and an oblique from the same place to the *external auditory meatus*. It measures in Europeans 80 to 85°, in Negroes 70°. The more pointed the angle proves, so much the more the animal conformation preponderates.

74. Vertebral column, back-bone, *columna, s. spina vertebrarum s. rachis.*

Extends from close beneath the cranium as low down as the *os coccyx* which forms its inferior extremity; contributes to form the Thoracic, Ventral, and Pelvic cavities; is gently curved, of an undulating figure, and contains an osseous canal, for the spinal marrow.

Constituent parts: a. *True vertebræ, 24; Cervical portion, 7; Thoracic or Dorsal, 12; Abdominal or Lumbar, 5.*

b. Sacrum, 5 false vertebræ blended together.

c. Coccygis, 4 false vertebræ blended together. These two together form the *Pelvic portion*.

75. 1. True vertebræ, *vertebræ veræ.*

7 Cervical vertebræ, *v. cervicales*; 12 Thoracic or Dorsal, *v. dorsales*; 5 Ventral or Lumbar, *v. lumbales*.

Figure: ring-shaped. Parts: Body, Arches, Processes; 1 Spinous, 2 Transverse, 4 Articular.

Connection; the 1st cervical vertebra with the skull, and with the 2d cervical vertebra, the 2d with the 3d, and so forth; the 5th Lumbar vertebra with the Sacrum; the 12 Dorsal, besides, with the ribs.

Position: one above the other.

a. Body, *corpus, centrum*, is the anterior, thickest, and most *essential part* of a vertebra; it presents *above* and *below* slightly concave surfaces covered with cartilage, for its junction with the vertebral body lying above and below it, is anteriorly convex; on the sides, evenly excavated and grooved; behind, concave and perforated by foramina, for vessels. This posterior surface forms with the

b. Arch, *arcus* [*neural arch* (Owen)], which springs from its posterior lateral parts, the vertebral foramen, *foram. spinale s. medullare*, which is triangular in almost all Vertebrae, and serves as a passage for the spinal marrow. The notches, *incisurae*, on the superior and inferior borders of every arch, form, the two together, an intervertebral foramen, *foram. intervertebrale*, for *art.* and *nerv. spinal.* upon each side.

c. Processes, *processus*, seven in number.

1. Muscular processes, *proc. musculares*, three to each vertebra;

a. *Processus Spinosus*, one Spinal process [*Neural spine*, (Owen)], behind in the centre of the arch; its root almost forked; its point, *apex*, freely projecting into the back, for the *lig. interspinos. apicum*, and the Extensor muscles of the trunk.

b. *Processus transversi*, two transverse processes, horizontal, one on each side between the *body* and arch projecting outwards, for *lig. intertransversalia*; and the obliquely ascending or descending cervical and dorsal muscles.

2. Articular processes, *proc. articulares s. obliqui*, two superior, two inferior, spring laterally from the arch, behind the transverse processes, project out above the plane of the vertebral body; are tipped with cartilage, and associated, the two of the one, with the two of the other vertebra.

76. Differences between the Vertebrae of the three regions.

	Cervical.	Dorsal.	Lumbar.
<i>Body</i>	Small, insignificant; the superior surface concave from without to within, laterally provided with elevated margins, which fit into corresponding depressions upon the sides of the body of the vertebra immediately above; inferior surface slightly convex.	Larger, higher; superior and inferior surface flat, heart-shaped; upon either side two half articular surfaces for the head, <i>capitulum</i> , of the ribs; on the eleventh and twelfth one whole one only.	As large again as the cervical, about one-third larger than the dorsal; superior surface concave, oval.

	Cervical.	Dorsal.	Lumbar.
<i>Foramen Spinale</i>	One, very wide, triangular.	Narrow, more wedge-shaped.	Broad, triangular.
<i>Incisura intervertebralis</i>	Superior and inferior. The inferior deeper than the superior.	The same.	The same.
<i>Proc. spinosus</i>	Short, thick, forked at the point; inferior surface grooved, for the vertebra immediately below, during extension, almost horizontal.	Long; apex blunt, tuberculous; directed downwards, and overlaying one another in an imbricated manner.	On the sides flat; the apex expanded into a crescentic enlargement; horizontal behind.
<i>Proc. obliqui</i>	Short, oval, flat; the superior oblique, 45° directed upwards and backwards, the inferior downwards and forwards.	Small; the superior directed backwards and outwards, the inferior inwards and forwards; almost perpendicular.	Strong; quite perpendicular; the superior concave directed inwards and backwards; the inferior convex outwards and forwards.
<i>Proc. transversi</i>	Broad; at the base perforated by <i>foram. vertebrale</i> , for the <i>art. vert.</i> , above grooved, for the <i>v. cervicales</i> .	Stronger; longer; horizontal; directed backwards, terminating roundly, and with an articular fossa, for <i>tuberculum costæ</i> .	Thin; narrow; flat from before to behind; on the same plane as the ribs; hence, <i>proc. costiformis</i> .

The most particular characters by which to recognize the different vertebræ, immediately, are:

1. Cervical vert.—*Foram. vertebrale*; the extremity of the *proc. Spinosus*.
2. Dorsal vert.—Articular surface upon the *body*; articular fossa on the *proc. transversus*.
3. Lumbar vert.—The want of those characters peculiar to the cervical and dorsal vertebræ. By the transverse processes we can most easily distinguish the vertebræ of one region from those of another.

77.

Separate Vertebræ.

I. *Atlas*, first cervical, lies like a ring at the circumference of the *foramen Magnum*, close to the skull, which it supports; consists of an anterior and a posterior segment. *Arcus anterior*, in the place of the vertebral body, is flat, convex anteriorly with a tubercle, *tuberculum anterius*, and on the concave posterior surface provided with a flat, egg-shaped, articular fossa for the *odontoid process* of the second cerv. vertebra. The lateral portions, *massæ laterales*, are strong, present above the concave *fossæ condyloideæ*, corresponding to the superior oblique processes, for the *proc. condyloid. occipitis*; below the round, flat, *proc. obliqui inferiores*, for the Epistropheus; upon the internal surfaces of either side a tubercle, *tuberculum laterale*, for the *ligam. transversum*. *Arcus posterior*, the largest part of the Atlas, consists of two narrow plates, which meet together at an angle and terminate with the *tuberculum*

postic., instead of the *proc. spinosus*.—*Proc. transversi* arise from the lateral portions, are strong and provided with an eminence, for the *oblique muscles of the head*.—*Incisuræ vertebrales* lie behind the *proc. obliqui*, are deep, and form, almost alone, *foram. intervertebral.*; the superior, for *art., ven., vertebral.*, and *n. cervical*, 1., forms with the *foram. vertebrale* a canal, often closed, which is at the commencement *vertical*, then *perpendicular*.—*Foramen spinale* wider than that of the other *vertebræ*.

II. *Epistropheus, axis, dentatus*, the second cervical vertebra, is particularly distinguished by its *odontoid process*, which projects six lines from the anterior superior part of the body; it has a broad *basis*, a contracted (brittle) portion, *collum*, and the *extremity* terminates in a tubercle, *apex*, for the *lig. odontoid*. Its *spinous process* is very long and strong, its *foram. spinale* cordiform and wide, its transverse process neither grooved nor bifid, the vertebral foramen passing obliquely outwards, and the superior articulating surfaces are nearly horizontal.

III. *Vertebra prominens*, seventh cervical.—The spinous process projects strongly backwards, and has only *one tubercle* at the apex.—*Foram. vertebrale*, sometimes wanting, is frequently very narrow. On the *body* there often is a *semiarticular fossa*, for the first rib.

IV. *First dorsal vertebra*.—On the body the projecting lateral borders as on the cervical *vertebræ*; besides, *one whole* articular surface for the *first rib* and half a one for the *second rib*.

V. *Eleventh dorsal vertebra*. A complete articular fossa for the eleventh rib; instead of the transverse process, a tubercle.—The *twelfth dorsal vertebra* is distinguished from the *eleventh* by the curved surface of the inferior articular processes, and their great projection in a vertical direction, downwards.

VI. Fifth lumbar vertebra. The *transverse processes* are much *larger* than those of the rest of the lumbar; the inferior articular processes are more widely separated, look directly forwards, are *flat, not convex*.

At the limits of any two regions, the characters of the *vertebræ* more nearly assimilate.

78. False Vertebrae, *Vert. spuria*.

There are nine pieces, which in the adult are united together into two bones.

79. 1. *Os Sacrum*,

originally consisting of five *vertebræ*, lies at the posterior, central part of the Pelvis, behind its point of junction with the thigh bones; above, it unites with the *last lumbar vertebra*, below with the *coccyx*, right and left with the hip bones.

Direction: oblique from before to behind, and from above to below, forming with the lumbar *vertebræ* an obtuse angle, *Promontorium s. angul. sacro-vertebalis*.

Figure: a quadrangular pyramid with a blunt apex, the base above.

Muscles: *glutæus. max.*; *ilio-costalis, s. Sacro-lumbalis*; *latissim. dorsi*; *pyriformis*; *multifidus spinæ*.

Base presents: a superior, oval articular surface, turned towards the inferior surface of the body of the last Lumbar vertebra; behind this, a triangular opening, formed of two planes, behind, a spinous process; two triangular lateral surfaces, which help to form the great pelvis; notches to form the last intervertebral foramina; two superior oblique processes.

Apex; blunt, with a transversely lying articular surface for the coccyx, behind the termination of the sulcus of the sacrum, two *sacral cornua*, which are the most inferior articular processes.

Surfaces:—

a. Anterior, concave, with four elevated transverse lines, marking the points of junction of the *vertebræ spur.*; on either side four anterior sacral foramina, for nerves and vessels. In this curvature lies the *Rectum*; *m. pyriformis* arises external to and between these foramina.

b. Posterior, close beneath the skin in the centre, convex; in the middle line the *Crista Sacralis*, a continuation of the *Spinous processes*, which, partially divided, has close to it, laterally, two flat furrows and four *foram. sacral. post.*, for the *nervi sacr. posterior*. Besides, the united *oblique processes* projecting more strongly outwards, and the *transverse processes, alæ sacral.* in one piece.

c. Lateral surfaces: triangular, above broad, below narrow, oblique from before to behind, and from without inwards. Anteriorly a semilunar articular surface, *facies auricularis*, for the *Hip bone*; behind it rough elevations for the post. sacro-iliac ligaments. Below on the indented borders the *Sacro-Ischiatic ligaments*.

Canalis sacralis is the termination of the *can. spinalis* triangular, above broad, below narrow, and terminating in a groove. Into it the *anterior* and *posterior sacral foramina* open; out of it the *Sacral nerves* come forth.

80. 2. *Os coccygis*, fundament, tail bone,

consists of four united flat tubercles, the size of which diminishes downwards; is flat, triangular, above, broad at the extremity of the Sacrum, below, pointed and free.

Direction: usually that of the sacrum, forming, sometimes with this bone a *right*, indeed, even an *acute* angle. Important in obstetrics.

Muscles: *glutæus maxim.*, *coccygeus*, *levator et sphincter ani*.

Basis, the most superior piece, often united to the os sacrum. Behind two cornua stand upwards from it; externally two notches, for the fifth pair of Sacral nerves.

Apex sometimes forked, or aside from the middle line. For the *levator Ani*.

Surfaces: Anterior. Before it lies the *rectum*.

Posterior, close beneath the skin, serves for the attachment of the *m. glutæus Max.*

Sides, narrow, indented, rough, for *Sacro-Ischiatic ligaments*.

Canalis Spinalis, Canal for the Spinal cord, is formed by the *foramina spinalia* lying over one another; it follows all the curvatures of the vertebral column, the diameters of which, however, differ from those of the canal.

Commencement: at the *great Occipital foramen*.

Termination: in the *sacrum*.

The largeness of the canal accommodates itself to the mobility of the particular regions of the vertebral column, and to those portions of the spinal cord whence the greatest number of nerve filaments passes off. In the cervical and lumbar regions the column is most moveable, the nerves forming the Brachial and Lumbar plexuses very numerous, the canal the *widest*; in the dorsal and pelvic portions the reverse.

The anterior wall of the canal is formed by the vertebral bodies lying close over one another, merely separated by the intervertebral ligaments, the posterior by the vertebral arches, the interspaces between which are closed by short extensible ligamentous masses, *ligament. flava*.

On both sides the *foram. intervertebralia* open into it.

Cānalis vertebralis, vertebral canal, on either side of the neck is formed by the over-lying *foram. vertebralia* of the *transverse processes*; it contains *arteria et vena vertebralis*.

81. *The Tissue of Vertebral Bodies,*

consists almost entirely of spongy substance with large meshes, covered externally with a thin layer of compact tissue. A great portion of the processes, and the whole of the arches, consist of the last mentioned.

The vertebræ are very richly supplied with blood-vessels. For this purpose we find on the dorsal surface of each vertebral body a horizontal canal, which divides into several and always smaller branches in the spongy substance, all of which are lined with a thin layer of compact bone and perforated by innumerable smaller foramina.

82. *Development of the Vertebral Column.*

In the first months of fœtal life the vertebral column forms the entire length of the trunk, at birth three-fifths, and in the adult only two-fifths of the length of the body.

In the first period of development the curvatures of the Vertebral column are wanting, later it becomes curved in the form of a wavy line, the convex surface in the neck is directed forwards, in the dorsal region backwards, in the lumbar region, again, forwards, and in the pelvic strongly backwards. The smallest deviation from the curvature in one of the above named parts produces corresponding deviations in the other parts.

Besides these there exists in the region of the 4th and 5th dorsal vertebræ, in the region of the Aortic arch, a lateral inclination; the concavity to the left, convexity to the right.

Abnormal curvatures, forwards, backwards, and laterally by wasting or destruction of the vertebræ, or by inactivity of the muscles of one side and preponderating activity of those of the other, occur.

In old age the vertebral column curved forwards frequently exhibits a union of several dorsal or lumbar vertebræ.

The height of the column differs according to age, increasing to about the twenty-fifth year, and decreasing upon the advance of old age. Its average vertical diameter measures 2 feet 2 inches.

The separate vertebræ are developed from three centres of ossification, at first on the lateral boundaries of the spinal canal, as a defence for the spinal cord, and vertebral body. Five other points of ossification are presented, only later, for the processes.

Ossification commences with the fortieth day of fetal life; a year after birth the two lateral portions first unite together, in the arch, and only in the third to the fourth year with the body; the ossifying points of the transverse and spinous processes are first united in the twentieth to the twenty-fifth year.

In the Sacrum and Coccyx ossification commences, first in the body, in the second to the third month; the junction of the many ossifying points takes place very late, sometimes not at all. From the fortieth to the sixtieth year the coccyx usually unites with the Sacrum, but it is generally more slow in females than in males.

83. Thoracic cavity, *chest, thorax s. pectus.*

Situation: between the seventh cervical and first lumbar vertebræ, below the clavicle.

Figure: conical, the base below, the obtuse apex turned towards the neck, flat from before to behind.

Parts: 1. Dorsal vertebræ, *vertebræ dorsales*, twelve; 2. Breast bone, *sternum*; 3. Ribs, *costæ s. pleuræ*, twenty-four.

84. I. *Sternum s. os pectoris*, Breast bone.

Position: anterior, central part of the chest.

Shape: flat, sword-shaped, above broad, one and a half to two inches, below, narrow, rounded; before, somewhat convex; behind, rather concave. Length, from five and a half to seven and a half inches; thickness, above, six lines; below, three lines.

1. *Manubrium Sterni*, handle, the most superior piece, for m. sterno-hyoidei, —thyreoidei,—mastoidei.

a. The superior border, concave, called *incisura semilunaris, s. Furcula* (Vügel); on either side *Incisura clavicularis*, an oblong articular surface for the clavicle.

b. Lateral borders, longer; with *Foveæ articulares* for the first and second ribs.

c. Inferior limit, a transverse line, the commencement of the body, where the second rib attaches.

2. *Corpus, s. Mucro*, middle piece, for m. triangularis and pectoral. major, the longest portion. *Foveæ articulares*, for 3 to 7 ribs. Transverse line.

3. *Processus ensiformis, s. xyphoides*, ensiform process, termination of the breast bone, for m. *rectus abdom.*, *Diaphragm*, flat, blunt pointed or forked at the end, generally cartilaginous, with one, sometimes two holes, for art. mammar. intern.

Structure: within, spongy; without, compact substance, covered with *membr. propria sterni*.

Development: Ossification commences late in the manubrium, about the fifth to the sixth fetal month, in the spaces between the extremities of the ribs. In the fifteenth to the sixteenth year there are five to six, later only three pieces to be seen. *Ossicula episternalia*, according to Breschet, rudimentary ribs, are some-

times present at the superior border of the sternum, one upon either side; they are generally rather larger than the Pisiform bone.

85. II. *Costæ*, Ribs, twenty-four.

Position: between the vertebral column and sternum; twelve upon either side.

Figure: flat, narrow, long, thin, elliptically curved, and directed from behind forwards, from above downwards.

Breadth: From three to six lines; thickness: one line.

Division: *Costæ veræ*, 7; *Costæ spurix*, false ribs, 5 upon either side.

Portions of each rib: Body, posterior and anterior termination.

Connection: with the twelve dorsal vertebræ, with the cartilages of the ribs and the sternum, with the last bone by means of the cartilages of the seven superior, or true ribs.

1. Posterior extremity, *Head*, presents: *Capitulum* with two semi-articular surfaces, uniting with bodies of the dorsal vertebræ, from the second to the tenth rib between the two vertebræ, on the eleventh and twelfth rib in the centre of the body [on the eleventh above the centre]. *Neck*, the thinnest part; rough, in relation with the *transverse* proc. of the vertebra *above* it; *Tuberculum*, tubercle, the *internal* portion, for the *transverse process* of the vertebra *below*; the *external* for *ligaments*; the termination of the neck of the rib.

2. Body, central portion, with the *Angulus costæ* not far from the *Tubercle*; has an external convex, rough, and an internal, concave, smooth surface, a *thick* superior, a *sharp* inferior border. On the last, within: *Sulcus costalis*, for the art., ven., and nerv. intercostalis.

3. Anterior extremity, with oval articular surfaces [*fossæ*] for the cartilages; at the last an obtuse angle.

The true ribs unite by their cartilages, immediately, with the sternum at an acute angle; increasing in length from above to below.

The false ribs, *c. spurix*, five, decrease from above to below in length; as well as their cartilages.

Particular ribs. 1. First rib, the smallest and broadest, with short and thick cartilage almost immoveable. The external surface; for *ven. subclavia*, before, for *art. subclavia*, behind—*m. scalenus antierius* and *subclavius*, looks upwards, the superior border inwards. On the *Capitulum* one articular surface; *Collum*, long, cylindrical; *Tuberculum*, projecting, angular; anterior extremity *broad*.

2. Second rib, as long again as the first, may lie horizontal, the angle very indistinct. External surface, above, for *m. serratus post. sup.*, *scalenus med. et post.* Internal surface obliquely downwards, with a very superficial groove.

3. Third rib, much larger, more arched below and before: angle more marked.

4. The eleventh and twelfth ribs, *Costæ fluctuantes*—very moveable; marked curve. *Collum*, *Tuberculum*, et *Sulcus*, wanting. On the *Capitulum* only one flat articular surface. Anterior extremity very thin and pointed. The eleventh is longer.

The costal cartilages are flat like the ribs, chiefly formed as these, and ossifying easily upon the surface. They are twenty-four, sometimes twenty-six, or only twenty-two.

The *external* extremity lies in the fossa at the anterior termination of the rib, the *internal* is either immediately united with the Sternum, in the true ribs, or with the inferior border of the rib above, as the eighth to the tenth costal cartilages, or extends freely into the abdominal walls, eleventh to the twelfth. The borders of the fifth to the seventh ribs are united together. The three superior are straight; the rest curve outwards. Length: the first rib is very short and thick, often ossified; the following to the seventh always longer; from the eighth to the twelfth always shorter; the twelfth only a few lines long. In general, the length of the cartilage measures one-fifth of that of the entire rib.

Structure of the ribs: it is similar to that of the flat bones generally.

Development: Ossification commences with the second month of foetal life, from the body outwards. The osseous nuclei in the *capitulum* and *tuberculum* appear only in the sixteenth year, and completely united in the twenty-fifth year.

86. *External surfaces of the Chest.*

1. Anterior region, much broader below than above, inclining from behind forwards, from above downwards. In the centre—*sternum*, laterally the costal cartilages with the intercostal spaces; externally on either side the *linea chondro-sternalis*, behind this the limit, namely the line of the anterior angles.

2. Lateral regions, more convex behind than before, presents the central piece and the interspaces of the ribs. *Intercostal spaces*: these decrease in breadth from above downwards; however, the two last are broader than those in the centre; and the space between the anterior is broader than between the posterior extremities of the ribs.

3. Posterior region, between the posterior angles. In the centre: 12 *Proc. spinosi dorsal*; close to these the *sulci vertebrales*; 12 *Proc. transversi*; the *articular connections* with the *tubercles*.

87. *Cavity of the Chest, Cavitas thoracis.*

Anterior wall; concave, breast bone: costal cartilages. Posterior wall; in the centre: the projecting column of the vertebral bodies; at the excavated sides, *fossæ pulmonales*, for the convex posterior surfaces of the lungs; posterior terminations of the ribs.

Lateral parieties, formed by the ribs.

Inferior wall, formed by the diaphragm.

Superior wall wanting; in place of it, an oblique opening inclining from above and behind downwards, for *Trachea*, *Æsophagus*, *ductus thoracicus*, the great *cervical* and *brachial vessels*, *nerv. vagus* and *phrenicus*, the *apex* of the *lungs*, several *muscles*.

The *aræx* of the cavity is *almost immoveable*; the rest of the part, and particularly of the *basis*, by means of the ribs, *very moveable*. It is *expanded in inspiration, contracted during expiration*.

In the fœtus are: 1. The diameters from *before to behind* greater than the *transverse* diameter, the *Sternum* projects, on account of the size of the *heart* and the *thymus gland*.

2. The *vertical* diameter *shorter*, since the diaphragm projects high upwards.

3. The ribs slightly curved, the *fossæ pulmonales* not yet developed, as the lungs have not yet respired.

4. The inferior opening *larger* in all directions, on account of the large size of the *Liver*.

88. The Pelvis,

formed of—1. The Sacrum and Coccyx ;

2. The hip, or unnamed bones, *ossa coxarum, s. innominata*, two.

It lies below the fifth lumbar vertebra, at the side and before the inferior parts of the vertebral column; contains a portion of the intestinal canal, and especially the organs of procreation [with those of micturition].

89. Os coxæ, Hip bones,

occupy the anterior sides of the Pelvis, are flat, and consist, *before* the age of *puberty*, of three separate bones,—the Ilium, Ischium, and Pubes, which are united together by their thickest parts in the Acetabulum.

Connection: behind with the *os sacrum*, before and below with each other, laterally with the thigh bones.

90. 1. Os Ilium,

is the largest and broadest piece; the most superior, and forms the lateral wall of the Pelvis; extends from the Sacrum to the superior third of the Acetabulum:

a. External surface; undulating, with 1 to 2 *lineæ arcuatæ externæ*, for *glutæus medius* and *minimus*; and a few foramina for vessels.

b. Internal surface; with *linea arcuata interna*, the limit between the superior part, for *m. Iliacus internus*, which is the lateral wall of the great pelvis, and the inferior portion, that of the lesser pelvis. Behind: *tuber Ilium* and *facies auricularis*, the articular surface for the Sacrum.

c. Crest of the hip, *Crista Ilii*, is the superior S-shaped border, for *m. latissimus dorsi*, and *quadratus lumborum*; with, 1. *labium externum*, for *obliq. externus*; 2. *lab. internum*, for *m. transvers. abdom.*; 3. *linea intermedia*, for *m. obliq. internus*.

d. Anterior border, descending at an obtuse angle with the *Spina Ilei ant.*

sup., for *m. sartorius*, *tensor fasciæ latæ* and—*inferior*, for *m. rectus femoris*; between the two spines and below the *spina inferior*, a notch, for *m. Iliacus*, terminates in the anterior horizontal ramus of the pubes, where is the *eminentia ileo-pectinæa*.

e. Posterior border, with *Spina ilei post. sup.*; *inferior*; *Incisura semilunaris*.

f. Inferior border, from the *Spina poster. infer.*, presents. *Incisura ischiadica major*, for *m. pyriformis*, *art.* and *nerv. glutæus, ischiadicus*, and *pudend. communis*.

91. 2. *Os ischii*, seat bone, for *m. levator ani*.

The most inferior portion; below and behind the Ilium.

a. *Corpus*, the *inferior* portion of the acetabulum. Internal surface smooth, forms the inferior portion of the small pelvis. Posterior border with *Spina ischii*, the limit between *Incisura ischiadica major* and *minor*, for *m. gemellus super.*, *coccygeus* and *Ligam. spinoso-sacrum*. Anterior border, commencement of the *obturator foramen*.

b. *Ramus descendens*, short and thick. Posterior border forms the *Incisura ischiadica minor*, for *m. obturator internus*, *art.*, *ven.*, *nerv. pudendus communis*, from *Spina ischii* to *Tuber ischii*, for *m. gemellus infer.*, *quadratus femoris*, *semitendinosus*, *semimembranosus*, *biceps*, *transversus perinæi*, *Ligam. tuberoso-sacrum*. Anterior border, sharp, assists in forming *obturator foramen*.

c. *Ramus ascendens*—ascends from *Tuber ischii* forwards and inwards, for *m. ischio-cavernosus*. Internal border forms the *internal* part of the *obturator foramen*. External border a part of the Pubic arch.

92. 3. *Os pubis s. pectinis*,

in the anterior region of the pelvis.

a. *Corpus*—the inner third portion of the acetabulum—with *Eminentia ileo-pectinæa*, for crural artery above the Acetabulum.

b. *Ramus horizontalis*, for *m. rect. abdom.*, *pyramidalis*—above. Superior border, sharp, *Pecten s. Crista pubis*, for *Pectinæus m.*, a continuation of *linea arcuata*, terminates in *Spina pubis*, for *ligam. Pouparti*. Inferior border, the superior part of the obturator foramen.

c. *Ramus descendens* for *m. adduct.*, *gracilis*, descends from the *Spina pubis*, to meet the *ram. ascend.* of the Ischium. External border forms the internal of the obturator foramen; internal border, with that of the other side, the *pubic symphysis*, over this *angulus pubis*, superior; beneath it the superior portion of the *pubic arch*.

Acetabulum, the hemispherical, hollow surface, in which the body of the three bony pieces meet together, lies on the external side of the pelvis obliquely outwards and downwards, and is destined for the reception of the thigh bones. Its crescentic, sharp edge, *supercilium*, has below and internally a deep *Incisura acetabuli*, for the vessels of the joint to enter, and is still more deepened by a tendinous ring, *labrum cartilagineum*. Above is a horizontal groove, for *tendo recti femor.*, beneath a deeper, for *tendo obturator externi*. The whole *external* surface is covered with cartilage, that is the *facies lunata*, to the small *Fovea* for the attachment of the *ligam. teres*. The internal surface turned towards the small pelvis is rather curved downwards and backwards,

passing to the *spina ischii*. Important at the time of labour on account of the turning of the fetal head.

The Obturator foramina, 2, *foramen obturatorium*, s. *ovale*, formed by the ischium and pubis, lies at the anterior region of the pelvis. At the superior external wall a groove, for *art., ven., nerv. obturatorius*; otherwise entirely closed by the *memb. obturatoria*. External boundary for the *m. obtur. extern.*; internal for *m. obtur. intern.*

Symphysis ossium pubis, in the central line of the body at the anterior region of the Pelvis, formed by the internal vertical borders of the two *ossa pubis*, 15 to 20 lines in height, higher in the male than the female. The articular surfaces are oval, flat, but directed obliquely from behind and internally to before and externally. There is a triangular space, with the apex behind, between them, which is filled with an elastic, strong, *Ligamentum interosseum pubis*. Besides this, three *ligamenta pubica* serve to unite the *pubes*, the most important of which, *triangulare*, assists in forming the pubic arch.

The Pubic arch, *Arcus pubis*, angular in the male, round in the female, is formed by the *ascending rami* of the *Ischia* on either side, by the *inferior* border of the *Ram. descend. os pubis*, and the *ligam. triangulare s. arcuatum*. Superior transverse diameter one inch, inferior three inches.

The *Sacro-Iliac symphysis* unites the *ossa innominata* behind with the *sacrum*, *superficies auriculares*, making a double angle, first vertical, then from behind to before. This articulation is also moveable, although not to the same extent as the *Symph. pubis*.

93. Cavity of the Pelvis, *cavitas pelvis*,

contains, a portion of the small intestines, the rectum, the urinary bladder, the internal organs of generation, vascular and nervous trunks.

1. *Pelvis major*, the great Pelvis; open before and behind, (closed behind, if we consider with the Obstetricians, that the fifth Lumbar vertebra forms a part of the pelvis,) formed by the *alæ* of the *Iliæ*, *fossæ iliacæ*, for *m. Iliacus intern.*, and the small intestine; is below narrower where the *linea arcuata* divides it from the small pelvis. Anterior transverse diameter between the *Spinæ anter. sup.* Eight to nine inches.

Linea arcuata, a crescentic raised line, passing from the centre of the superior border of the *Sacrum*; over this, the *Ilium* and the *os pubis* to the *anterior spine* of the *pubis*.

Promontorium—angle of the *fifth lumbar* vertebra with the *sacrum*.

2. *Pelvis minor*, the small pelvis at the superior and inferior outlet narrower than in the centre.

a. *Apertura superior*, elliptical or oval, with three diameters:

1. Straight diam., *conjugata* [antero-posterior] = 4 inches, from Promontory to superior border of symphysis pubis.

2. Transverse diam. = 5 inches from the centre of the *linea arcuata* of the one to that of the opposite side.

3. Oblique diam., *Diam. Deventeri*, two, = $4\frac{1}{2}$ inches from sacro-iliac sym-

physis of the one side to the ileo-pectineal eminence at the superior border of the Acetabulum of the other.

b. *Cavum pelvis minoris*, formed, *behind*, by the *Sacrum* and *Coccyx*, the cavity of which is 4 inches 6 lines, and depth 10 to 12 lines; *anteriorly* by the *symphysis* and *ossa pubis* with *foram. obturator*; laterally by oss. Ischii. Diameter.

1. Straight diameter [ant. posterior] = $4\frac{1}{2}$ inches from the centre between the second and third pieces of the Sacrum to the Symphysis pubis.

2. Transverse diam. = 4 inches between the Spina ischii, before and above them.

c. *Apertura inferior*, pelvic outlet, formed by the *apex* of the *coccyx*, the *Tuber Ischii*, and *Arcus pubis*; has three notches; *arcus pubis* and *Incisuræ ischiadicæ*.

1. Straight diam. [ant. post.] = $3\frac{1}{2}$ to 4 inches from the apex of the coccyx to the crown of the pubic arch.

2. Transverse diam. = 4 inches from internal border of one Tuber Ischii to the other.

3. Oblique diam., two, = 4 inches from the centre of the ligam. sacro-ischiadic of one to the Tuber Ischii of the other side.

The *axis* of the *small pelvis*, that is, a perpendicular drawn through the centre of the straight diameter, passes *above* obliquely backwards, *below* obliquely forwards. *Inclination*. The *Promontory* lies $3\frac{1}{2}$ to 4 inches higher than the superior border of the Symphysis pubis, and the Conjugata therefore makes with a horizontal line an angle of 60° . The apex of coccyx lies $\frac{1}{2}$ to 1 inch higher than the inferior border of the Symphysis pubis.

Development of the Bones of the Pelvis.

Ossification commences in the acetabulum, first, that is, in the body of the Ilium, in the fourth month of the fœtus. At the age of puberty the inferior border of the Ischium and the crista Illi first ossify, and the last only unites with the rest of the bone at the twentieth to the twenty-fifth year.

In young children, and even more in the unborn, the pelvis is relatively much more narrow, and strongly inclined, so that the urinary bladder lies with its whole anterior surface on the abdominal parietes, instead of in the lesser pelvis. Characters of the female pelvis, vide 109.

Bones of the Extremities, *Ossa extremitatum*.

A. Thoracic extremities, arms, *extremitates superiores*, s. *thoracicæ*, *Brachia*.

94. I. Shoulder, *Humerus*,

consists of the shoulder-blade and collar-bone.

1. *Scapula*, *Omoplata*, Shoulder-blade.

Position: behind on the Thorax, behind the second to the seventh ribs on either side of the vertebral column, very moveable.

Shape: triangular, shield-like, flat.

Portions: 2 surfaces, 3 borders and angles.

Connection: with the Clavicle and Humerus.

a. Anterior surface, turned towards the ribs, concave; this is *Fossa subscapularis*, for *m. subscapular*., lying close to the surface of the back; *Scapulæ alatz* stand off from it.

b. Posterior surface, divided into the smaller superior *fossa supraspinata*, for *m. supraspinatus*, and a larger inferior *fossa infraspinata*, for *m. infraspinatus*, by the ridge, *Spina scapulæ*, for *trapezius*, *deltoid*: this is triangular, presents a superior and inferior surface, an external short, and a posterior thick border, close beneath the skin, with a triangular surface, for the *m. Trapezius*; passes forwards, upwards and outwards, to the top of the shoulder, *Acromion*, which, triangular and flat, projects over the shoulder, protects the articulation above and behind, and possesses at the superior border a small articular surface for the *Clavicle*.

c. Borders: 1. Internal, Vertebral border, *Basis scapulæ*, the longest, with an external lip, for *m. rhomboideæ*, and an internal, for *m. serratus antic. major*.

2. External border, the thickest, inclined downwards and forwards towards the arm [the axillary border], for *m. teretes et anconæus longus* [long head of the Triceps], above.

3. Superior border, sharp, small, for *m. omohyoideus* with *Incisuræ scapulæ s. lunata*, formed into a foramen by *ligam. transversum*, for *nerv. suprascapular*; it passes into the coracoid process.

d. Angles: 1. Internal, almost a right angle, for *m. lev. anguli scapulæ*.

2. Inferior, very pointed, *m. Serratus magnus*, attached to it, separated from the skin by *m. latissimus dorsi*.

3. External, is the oval, vertical *Condylus scap.* with the surface *Cavitas glenoidalis*, the articular fossa for the head of the *humerus*, supported by a *Collum scapulæ* under which the *Incisum colli*, the junction of the *fossæ supra et infra spinata*, over which the *Process. coracoideus* projects, for the short head of the *biceps*, at the apex *m. coraco-brachialis*, *pectoral. minor*, farther above, *ligam. coraco-clavicularia*, *acromiale*. *Proc. coracoid.* bends under the clavicle, forwards and outwards over the shoulder joint, and protects it from before.

Development: ossification commences in the centre, at the end of the second month of the fœtus. In advanced childhood the coracoid and acromion are still cartilaginous; they contain, like the posterior border and inferior angle, but not the *spina*, special osseous nuclei. The *acromion* has two, but later. The P. coracoid unites with the body of the bone in the fifteenth to the sixteenth year, the remaining points, especially the inferior border, only after full growth.

95. 2. Clavicula, furcula, Collar-bones, 2.

Position: before and above the first rib, between shoulder-blade and breast-bone, horizontal.

Direction: both converge forwards and rather downwards, to the Sternum.

Figure: cylindrical, sigmoidal, at the internal extremity thick and round, external flat.

Curvatures: convex, anteriorly, in the sternal, posteriorly, in the acromial half.

Connection: with the breast bone, the shoulder-blade, and often, with the first rib.

a. Body, middle piece, almost immediately under the skin, is frequently fractured, with *Tuberculum* for *m. Cleido-mastoid*. Inferior surface, externally broad, with a rough line, for *m. Subclavius*; with an articular surface internally, for the first rib; in the middle third corresponding to the first intercostal space, for *Plex. brachialis et Vasa axillaria*; the outer third, united with *Proc. coracoid*. by the *ligam. Conoid. et Trapezoid*. Posterior border, two-thirds concave, one-third convex, externally. Lies on *Subclavian vein*; behind that *Art. et Plexus brachialis*.

b. External termination, *extremitas acromialis*, for *m. trapezius et deltoideus*, flat, weak, and easily broken; with an articular surface for *Acromion*.

c. Internal termination, *extremitas sternalis*, enlarged, angular, covered with cartilage, projects over the articular surface of the *Manubrium sterni* into the *incisura clavicularis* of which, it is received; for *m. sterno-cleido-mastoid*., and *pectoralis major*.

Varieties. In the female the Clavicle is more slender, less curved, and more horizontal. Structure: The medullary canal in the interior of the Clavicle is very small; the extremities consist of more Spongy tissue.

Development, at a very early period, at the thirtieth to the thirty-fifth day from one osseous nucleus in the centre. In the fifteenth to the eighteenth year an osseous nucleus appears as a thin disc at the sternal end. In mature childhood the humerus is only about $\frac{1}{4}$, in adults $\frac{1}{2}$ larger than the clavicle.

The shoulder is placed before and behind close to the Thorax, but stands out from it, and the space thereby formed forms the superior part of the cavity of the axilla.

96. II. *Os humeri s. brachii*, Bone of the upper arm.

Position: between shoulder and fore-arm, on the sides of the chest.

Length: reaching downwards to the second Lumbar vertebra, farther in Negroes.

Direction: parallel with the axis of the trunk, yet rather oblique from above downwards, and without inwards.

Figure: tubular, cylindrical.

Connection: with the shoulder-blade and the fore-arm.

a. Superior extremity with: 1. *Caput humeri*, a segment of a sphere, about $\frac{1}{3}$; lies in the *Cavit. glenoid. scapulæ*, is surrounded by a circular flat groove, the *Collum humeri* of Anatomists, and forms an obtuse angle with

the axis of the shaft of the bone. 2. *Tuberculum majus*, on the outer side, with three surfaces, for *m. supra-, infraspinatus*, et *Teres minor*. 3. *Tuberculum minus*, anterior, for *m. subscapularis*. 4. *Sulcus longitudinalis*, between the two tubercles, for the tendon of the *Caput long. bicipitis*. 5. *Spina tuberc. major*, for *m. pect. maj. et deltoideus*. 6. *Spina tuberc. min.*, for *m. teres maj., latiss. dorsi*, et *coraco-brachial*. 7. *Collum humeri chirurgorum* at the superior sixth of the humerus and the point of transition into

b. The middle piece, *the body*. Superior half cylindrical, inferior, triangular, prismatic.

1. Surfaces: external, below the superior third a V shaped depression, for *m. Deltoideus*. Internal anterior surface, for *m. brachialis internus*, oblique from above, downwards, and from before, inwards, the course of the *Art. brachialis*, presents: *Foram. nutritium*. Posterior surface below very broad, for *m. triceps*.

2. Edges, angles. Anterior, roundish, rough, the commencement of *spina tuberc. major*. External, above indistinct, below, sharp, before curved, for *cap. intern. tricip. et supinator longus*. More obliquely below, likewise, sharp—from *Spina tuberc. minoris*—for *cap. intern. tricip.*

c. Inferior extremity flat, broad; presents, from without inwards: 1. *Condylus externus*, for the *extensor and supinator muscles*. 2. *Eminentia capitata s. rotula*, the small articular head, unites with the Radius of the fore-arm. 3. *Trochlea*, it receives the Ulna. Above it we find *Fossa ant. maj.* for *Proc. coronoideus ulnæ minor*, for the *radius*;—posterior, for *Olecranon*. 4. *Condylus internus*, for the *flexor muscles, pronator teres*, and *palmar. long.*, behind with a flat groove, for *nerv. ulnaris*.

Structure. At the extremities spongy tissue, in the body compact substance and medullary cavity.

Development commences early, second month, in the centre; both extremities still remain cartilaginous in the second year; then at the superior extremity, for *caput and tuberc. majus et minus*, three osseous nuclei appear; lastly, at the inferior extremity four osseous centres. In the eighteenth to the twentieth year the extremities first unite with the centre piece, the inferior soonest.

97. III. *Ossa antibrachii*, Bones of the fore-arm.

1. *Ulna s. cubitus*, Elbow.

Position: on the inside of the radius, between upper arm and hand, on the same side as the little finger.

Shape: prismatic, triangular, rather twisted; above thicker than below; longer than the radius.

Direction: rather oblique from above, downwards and outwards.

Connection: with the upper arm, the radius and cuneiform bone by the *ligam. capsulare sacciforme*.

a. Superior extremity, behind, has the hook-like process, *Proc. anconæus s. Olecranon*, for the *Anconeus muscle*, the extremity of which moves in the *fossa olecrani post.*; anteriorly, *Proc. coronoideus*, for *m. Brachialis internus*, the point

of which moves in the *Fovea anterior*; the *Basis* in which the *Olecranon* and *Coronoid processes* meet together, is thin and brittle; between the two: *Fossa sigmoidea maj.*; for the *Trochlea* of the upper arm; *minor* on the outer border of the *Coronoid process for capitulum radii*; under that a rough, deep, triangular surface, for *m. supinator brevis*.

b. Centre piece, shaft, 1. Surfaces; Anterior, *Volar*; above broad, with *foram. nutritium*. Muscles: *flex. digit. et pollic. long., carpi ulnaris*. Posterior surface: somewhat convex, divided by a longitudinal line. Internal surface: above very broad; below narrow, and close beneath the skin, smooth.

2. Borders. External, *crista*, the sharpest, particularly in the centre, diminishes below for *abduct. long. et extens. brevis. pollic., ligam. interosseum*. Anterior or internal, obtuse, for *flex. digitor. comm., pronator quad.* Posterior: commences below the *Olecranon*, and is lost on the inferior fourth; perceptible through the skin.

c. Inferior extremity, for *M. pronator quadratus. Capitulum s. condylus ulnae* unites with the inferior extremity of the *Radius* and the *cuneiform bone*. Internal to the small head, *Proc. styloideus*, for *ligam. laterale intern.* of the hand and fore-arm; between the two a hollow, for *ligam. triangulare*.

Structure. Compact in the centre, spongy at both extremities, particularly at the elbow. *Olecranon* sometimes forms a special bone.

Development: three osseous nuclei. The first appears in the body at the thirty-fifth to the fortieth day of the fœtus. The extremities only ossify with the sixth year, and the inferior first. In the fifteenth to the sixteenth year the middle unites with the superior, in the eighteenth to the twentieth year with the inferior extremity.

98.

2. Radius.

Position: on the outer side of the *Ulna*, on the same border as the thumb,—*radial border*.

Shape: prismatic and triangular, above thin, below thick; in the centre slightly curved.

Connection: with the *upper arm, rotula proc. cubital., Ulna*, the wrist, *os lunare, naviculare*.

a. Superior extremity. 1. *Capitulum radii*, with a lateral, annular, articular surface, *circumferent. articular.*, for the *fossa sigmoid. minor*, and a superior, for the *rotula*.

2. *Collum*, five to six lines long, inferior limit of which:

3. *Tuberositas radii*, for *m. biceps*, the *tendon*; behind, rough; before, smooth.

b. Central piece, shaft, slightly curved, internally concave. 1. Borders: *anterior*, blunt, commences from the *tuberosity*, passes obliquely outwards, and terminates below, before the *Proc. styloideus*; *posterior*, above and below slightly marked; *external*, for *ligam. interosseum, Crista*, from the *tuberosity* to a small articular surface below and internal.

2. Surfaces: Anterior; above, narrow; below, broad; with *foram. Nutritium*, for *m. supinator brevis, flex. pollicis long., digitor. commun. sublimis*. External surface, convex, for *m. Pronator teres*. Posterior surface, rather hollow, for *m. abduct. pollicis longus*.

b. Inferior extremity, thick, quadrangular, for *m. pronator quadratus*, with

an inferior, concave, divided, articular surface, 1. *Cavitas glenoidalis*, for *os naviculare*, on the outside, *os lunatum* on the inside. 2. Externally: *proc. styloideus*, for *supinat. longus*, between the anterior and external border, a groove, for *m. abduct. long.* and *extens. brevis pollicis*. On the circumference upon the dorsal aspect. 3. Two grooves, for the tendons of the *extens. carpi radial. long.* and *brevior*; anteriorly, for those of the *extens. digit. comm.*, and behind, *pollic. long.* *Incisura semilunaris*, in which the *Capitulum Ulnæ* moves.

Development proceeds from three osseous points, first in the central piece; in the inferior extremity, towards the third year, in the superior towards the ninth; the last unites with the shaft in the twelfth year; the first in the eighteenth to the twentieth.

99. IV. *Ossa manus*, Bones of the hand.

1. *Carpus*, root of the hand, wrist, about an inch long, $2\frac{1}{2}$ broad, consists of eight short bones, lying close together in two rows, one above the other, and four bones in each. The wrist is united above, with the fore-arm; below, with the metacarpal bones; concave upon its anterior or palmar surface, hollow of the hand, it forms with the *ligam. carp. volare prop.*, a ring for the tendons of the *flexor muscles*; convex on the posterior, dorsal surface. It presents an Ulnar and Radial border,—*Vola*, palmar—*Dorsum manus*, dorsal surface, back of the hand.

Eminentia carpi are two projections on either border of the palmar surface.

At the ulnar border: 1. the superior, *os pisiforme*; 2. the inferior, the hooked process of the *unciform bone*.

At the radial: 1. the superior, *os naviculare*; 2. the inferior, *os trapezium*.

a. Bones of the superior row passing from the *Radial* to the *Ulnar* border.

1. *Os naviculare* s. *Scaphoideum* lies below the radius, above three bones of the second row, with a deep, articular fossa, for *os Magnum*, with a convex, articular surface, for *oss. trapezium et trapezoid.*, the largest bone of the first row.

2. *Os lunatum, semilunare*, lunar bone, lies below the radius above the *os magnum*, between 1. and 3.

3. *Os [cuneiforme] triquetrum*, pyramidal bone, below the Ulna, above the unciform bone.

These three bones, when united, are convex above, concave below. They are connected with the fore-arm.

4. *Os pisiforme*, pea-like bone, for *flex. carpi ulnaris, abduct. digiti 5*, lies free in the hollow of the hand, only united with the pyramidal bone [cuneiform] at the ulnar border.

b. Bones of the inferior row from the radial to the ulnar border.

1. *Os [Trapezium]* multangulum majus, for *opponens*, *abductor brevis pollicis*, below the navicular, above the first metacarpal bone; with a groove in its palmar surface, for the tendon of the *flexor. carp. rad.*

2. *Os [Trapezoides]*, multangulum minus, s. pyramidale, for *flex. pollicis brevis*, below the navicular, above the second *Os Metacarpi*. *Ossa multangula* form a *concave*, articular surface, for *os naviculare*.

3. *Os [magnum]*, capitatum, for *adductor. and flex. brevis pollicis*, below the scaphoid and semilunar bones, above the third metacarpal bones; with *Capitulum*.—The largest bone of the second row.

4. *Os [unciforme]*, hamatum, hooked bone, below the cuneiform, above the *oss. metacarp. iv. and v.* Its hook, *proc. uncinatus*, for *m. flex. brevis et opponens digiti 5*, lies close to the *pisiform bone*.

Os capitatum et hamatum form an articular head, for the *articular fossa* of the first row.—The Middle bones have four, the external only three articular surfaces.

Structure. The carpal bones consist of a spongy, bony mass, covered externally with compact tissue. Ossification commences after birth; at the end of the first year in the *magnum* and the *unciform bone*; between the third and fourth years in the *cuneiform*; between the fourth and fifth in the *trapezium* and *semilunar*; between the eighth and ninth in *os naviculare* and *trapezoid*; between the twelfth and fifteenth in *os pisiforme*, which is generally the latest perfected of all the bones.

100.

2. *Metacarpus*, Middle hand,

consists of five parallel, columnar bones, which, united together like a grating, are connected with the carpal bones and phalanges of the fingers.

a. Superior carpal end, *Basis*; enlarged, rather hollowed out, for the reception of the carpal bones; tri- or quadrangular, with two small lateral surfaces to receive the lateral metacarpal bones.

Basis. oss. Metacarp.

I. For *abduct. poll. long.*, unites with *os trapezium*.

II. For *flex. et extens. carp. rad. longior.*, with *os [Trapezium]*, *Trapezoid*, and *[Magnum]*.

III. For *extens. carp. rad. brev.*, with *os magnum*.

IV. With *os [magnum]* and *unciforme*.

V. For *extens. carpi ulnaris.*, with *os unciforme*.

b. Central part, for *m. interossei*, roundish, triangular, rather concave on the palmar aspect.

c. Inferior, digital end, *capitulum*, with *two tubercula* and *one sinus* on either side.

Capitul. oss. metacarpi: I. for *m. opponens, abduct. brev. pollic.*

V. for *m. opp. minimi digit.*

I., The metacarpal bone of the *thumb*, is *shorter and thicker* than the rest; has no lateral articular surfaces, and is moveable in a free joint, *Arthrodia*.

II. is the *longest*, has on its *base* only *one lateral* articular surface. A little shorter, but thicker, is

III., with *two lateral* articular surfaces.

IV. is shorter, and V. shorter still. The last has only one articular surface, but a *tubercle* on the *base*, for *m. extens. carp. ulnaris*.

Structure, as in the long bones, spongy substance at the ends, compact in the centre, medullary canal, but narrow, in the interior.

Development; from two osseous points, one for the centre and superior, one for the inferior extremity. The I. metacarpal at the superior end like the phalanges, which it also resembles. At birth the central piece is almost entirely ossified; at the extremities ossification commences between the second and third year, and is only completed with the eighteenth to the twentieth year.

101.

3. *Digiti*, fingers.

On either hand there are five articulated pyramids, each of which unites with one of the five metacarpal bones.

I. Finger, *thumb*, has two, the rest three members, *phalanges*. The first of the three, or two members, is united with the end of the metacarpal bone, the third (second) is free, as the *ungual*. Each phalanx has a superior, hollowed extremity, for the reception of the bone lying above it, an anterior concave body, and an inferior roller-like end, for its junction with the phalanx below; only the ungual member, *phalanx unguicularis*, terminates in a semilunar end.

I. Thumb, *pollex*; in it the centre Phalanx is wanting; on the base of the first, at the metacarpal end in the hollow of the hand, lies an *os sesamoideum externum*, for *m. flexor pollicis brevis*, and *internum*, for *m. abductor pollicis*.

1. Phalanx—sup. Extremity, for *extens. et abd. brevis*.

2. " " for *flex. et extens. long.*

II. Index finger.

1. Phalanx, Radial side, for *m. lumbricalis I., Interosseus*.

2. " for *m. flex. comm. subl., extens. comm.*

3. " for *m. flex. comm. prof., extens. prop.*

III. Middle finger, *digitus med.*, muscles as in II.; the last excepted.

IV. Ring finger, *dig. annularis*, as in III.

V. Ear finger, *dig. auricularis s. minimus*.

1. Phalanx, for *abduct. et flex. brevis*.

2. " for *flex. comm. subl., opponens*.

3. " for *flex. comm. profundus*.

Development. Each of the phalanges is ossified from two points, the body and the inferior extremity, in the third fœtal month. The extremity first unites with the body between the eighteenth and twentieth year after birth.

Abdominal Extremities.

B. *Extremitates inferiores s. abdominales*.

102.

I. *Os femoris*, Thigh-bone.

Position: close to and beneath the Pelvis, above the leg.

Shape: long, cylindrical, with thick extremities: the longest bone in the body.

Direction: from above to below, and from without to within, particularly in the female.

Connection: with the acetabulum of the pelvis and the shin-bone.

a. Superior extremity—taking a course from the shaft or centre piece from without, inwards and upwards. On it,

1. *Caput femoris*, head of the thigh bone, almost two-thirds of a sphere with fovea, for *ligam. teres*.

2. *Collum*, neck of the thigh bone; forms with the central piece an obtuse angle; flat. Anterior surface short, posterior longer and rather concave. Behind it

3. *Trochanter Major*, above and externally in a plane with the *corpus femoris*, for *m. gluteus med. and minimus, pyriformis, quadratus femoris*, with: *Fossa trochanterica*, for *m. gemelli et obturatores*.

4. *Trochanter Minor*, below and internally from the base of the neck, for the tendon of the *m. Psoas et iliacus*.

5. *Linea intertrochanterica anterior*, for *m. cruralis*, posterior, [part] for *m. quadratus femoris*.

b. Centre piece, body. Anterior surface rather convex, inferior broader than above, for *m. cruralis*. Internal surface, flat, below broader and directed backwards, indicating course of *art. femoralis*. External surface, narrow, in the longitudinal direction rather concave; the external and internal borders are roundish. Posterior border, sharp and rough, the *Linea aspera*; above and below divided. Above, the external angle terminates in the *Trochant. major*, the internal, the more feeble, in *Troch. minor*.

Internal angle, for *m. pectineus adductor brevis, vastus intern.*

External angle, for *m. Gluteus max., adductor magnus, vastus externus, Caput breve bicipitis*.

Centre, the *linea aspera*, for *m. adductor longus et magnus*, with: *Foramen nutritium*. Below, the *Linea aspera* terminates in the two condyles, for the *m. gastrocnemii*, between which is a triangular space, the superior part of the *fossa poplitea*, for *art. ven., et nerv. popliteus*.

c. Inferior extremity broad, flat from before to behind; with

1. *Condylus externus*, for *m. Popliteus, plantaris, Cap. extern. m. gastroc.* upon a plane with the *corp. femoris*.

2. *Condylus intern.* projects very much inwards from the axis, for *Cap. intern. m. gastroc.*

On the articular head:

1. Inferior articular surface, for the *tibia* and *patella*.

2. *Tuberositas interna* projects greatly; over it a surface, for *m. adduct. magnus; externa*, less marked, with a tubercle. Both for *ligamenta cruciata*.

Between them:

3. Posterior *Fossa intercondyloidea*, forms the fossa of the knee.

4. Anterior *Trochlea femoris*, corresponds to the *Patella*.

Structure: type of the long bones.

Development: five osseous centres: one, for the body, one for each extremity, one for each Trochanter. The *first* appears in the *body*, between the fortieth and fiftieth days; the second in the *inferior extremity*, regularly, in short, before the maturity of the *fœtus*; the *third* in the middle of the *head* at the end of the first

year. The *neck* ossifies by extension from the *body*. The *Trochanter major* ossifies in the fourth year,—*minor* in the thirteenth or fourteenth. Both are first united to the head towards the twenty-eighth year, the other parts soon after puberty.

103. II. *Ossa cruris*, Bones of the leg.

1. *Tibia*, shin-bone.

Position: below the thigh-bone, above the foot, on the inside of the *Fibula*, on the same border as great toe, *Tibial*.

Direction: vertical.

Shape: three-sided, prismatic; above and below enlarged. The strongest and longest bone next to the femur.

Connection: with *os femoris*, *Fibula* (immoveable); *Astragalus*; the Patella by *ligam. Patellæ*.

a. Superior extremity, *caput tibiæ*, broad, much stronger than the inferior extremity.

1. *Cavitas glenoidalis interna*, longer and deeper than *externa*. Both oval, concave, for *Condylus femoris*; divided by

2. *Eminentia intermedia*, pyramidal, rather posterior, for *ligam. cruciata*; supported by

3. *Condylus internus*, behind with a horizontal groove, for the *Tendon of Semimembranosus*, and by *Condylus extern.*, a slight enlargement with the small external *superficies peronææ*, for the *head of the fibula*. Posteriorly between the condyles—a deeper notch, *incisura poplitea*; before a triangular surface with several *foramina*, and under that,

4. *Spina tibiæ*, rough, for *tendo communis recti, crural., vasti*, externally and above a tubercle, for *m. tibial. anticus*.

b. Central piece; three-sided, thick, weakest in the inferior third.

Internal surface, above, covered by an Aponeurosis, *pes anserinus*, below only by the external *skin*, above broad and oblique from before inwards, inferior fourth narrow and directed directly inwards.

External surface, for *m. tibial. ant. et extens. digit. comm.*, above concave, below directed forwards.

Posterior surface, for *m. tibialis posticus* and *flex. digit. comm.*, above broad; with *Linea obliqua*, for *m. Soleus*, and a triangular surface, for *m. popliteus*; *Foramen nutritium*.

Anterior border, *Crista tibia*, close under the skin, sharp, rounded in the inferior fourth: continuation of Spina.

External border, for *ligam. inteross.*, divided below.

Internal border, obtuse, for *m. sartor., gracilis et semitendinosus*.

c. Inferior extremity, basis, almost four-sided, broad; before convex, for the *Extensor tendons*; behind, even with a slight *fossæ*, for *tendo m. flex. hallucis long.*; externally, a triangular fossa, *Incisura fibularis*, for the *Fibula*; internally, the thick four-sided *Malleolus internus*, springing strongly forwards. The posterior border of the internal malleolus presents an oblique *fossa* descending from without inwards, for the tendons of *tibial. post. et flex. digit. long.* The external surface assists in forming the inferior articular surface. This last, *fossa glenoidalis*, is four-sided, broader externally, divided by an elevation into two lateral halves, and it unites with the *Astragalus*.

Structure. The spongy mass of the Extremities is perforated by numerous vascular foramina.

Development. Three osseous points. In the body the first appears between the thirty-fifth and fortieth days; in the superior extremity with the conclusion of the first year; in the inferior extremity in the course of the second. The union of the three portions commences at the inferior extremity, and is only perfect when the growth is complete, between the eighteenth and the twenty-fifth year.

104.

2. *Fibula s. Perone.*

Position: upon the outer, as well as above, upon the posterior side of the shin bone, on the same side as the little toe of the foot, —Fibula border.

Direction: vertical, below a little external.

Figure: thin, long, like the tibia, twisted.

Connection: with the *tibia*, the *astragalus*; and with the *os femoris* by the *ligam. lateralia*.

a. Superior extremity, *capitulum*; with: *superficies tibialis superior*, the concave articular surface of the Tibia; externally, flat fossæ for *ligam. lateralia extern. et m. biceps*; behind; and above the point, *apex seu proc. styloideus*, for *m. biceps*.

b. Central piece, three-sided, prismatic. External surface, grooved, for *m. peronæus long. et brevis*, inferiorly one-fifth directed backwards.

Internal surface, divided by a *Crista*, for *lig. interosseum* into two halves, for *Tibial postic.*, *peronæus tertius*, and *extens. hallucis longus*; below turned forwards.

Posterior surface, above narrow, below broad and directed inwards, with *Foram. nutritium*. Muscles: *soleus*, *flex. hallucis longus*. The borders are sharp; the internal, for *ligam. interosseum* inclines forwards, the anterior outwards, the external backwards.

c. Inferior extremity, projects beyond the articular surface of the *Tibia*, is longer and thicker than the inferior extremity of the last. *Malleolus externus*: external surface convex, lies close beneath the skin; internal surface forms the articular fossa for the astragalus and unites with the Tibia; with *Tuberculum anticum et posticum*, for the *ligam. tibio-fibularia*; posterior surface, grooved for the tendons of the two *peronæi*, with *fossa malleoli externa*, for *ligam. fibulare tali post.*

Structure. The medullary canal in the centre is very narrow; the extremities are spongy.

Development. Three osseous nuclei; the first, in the centre piece, appears between the fortieth and fiftieth days, fetal; the second, in the inferior extremity only, in the second year; the third, at the superior extremity, in the fifth year. The inferior extremity first unites with the body, between the twentieth and the twenty-fifth year.

105. 3. *Patella* s. *Rotula*, Knee-pan.

Position: between *femur* and *tibia*, before the knee. The largest *os sesamoideum*.

Figure: flat, roundish, triangular, however very variable; above broad, below pointed.

Connection: with the *femur* and *tibia*.

a. Anterior surface, convex, covered by a thick fibrous tissue, beneath the skin.

b. Posterior surface, fits close upon the *Trochlea* of the inferior extremity or the *femur*; is covered with cartilage, and presents:

1. *Crista*, from above, downwards and inwards.

2. *Fossa articular. externa*, broad, and *interna*, narrow.

c. Circumference. Superior border, *basis*, thick, for the *tendons* of the *extensors* of the leg. Lateral borders, for *lig. capsulare*. Point, *apex*, lies towards the *Spina tibiæ* [for *ligam. Patellæ*].

In flexion of the leg upon the thigh the *Patella* remains fixed and projects, in extension it is moveable and serves as a roller for the *Extensor muscles*.

Structure. Entirely spongy, only covered upon the anterior surface with a thin layer of compact tissue which, as an exception in these short bones, consists of longitudinal fibres.

Development. From one osseous centre in the third year.

III. *Ossa pedis*, Bones of the feet.106. 1. *Tarsus*, root of the foot, instep,

consists of seven bones, placed unequally in two rows; arched above, hollow below.

a. Posterior row, consists of the two largest bones of the *Tarsus*.

1. *Astragalus* s. *Talus*, knuckle bone. Situation and connection: below the *Tibia*, above the *Calcis*, internal to *Malleolus externus*, *fibulæ*, behind the *navicular* bone. Figure irregularly cubical. Six surfaces. Body and head.

a. Body. Superior surface, a half *trochlea* for the *tibia*; Lateral surfaces flat, enclosed by the *malleoli*. Inferior surface, for *calcaneus*, concave. Posterior surface with a groove, for *flex. halluc. long.*

b. Head, for *os naviculare*, united to the body by the *Collum astrag.*, has above, a broad notch, before, an articular surface, for *os naviculare*, below, a fossa which forms with another on the *Proc. anterior Calcanei*, the *Sinus tarsi*; lies on the anterior surface of the *astragalus*.

2. *Calcaneus*, heel bone, the largest of the tarsal bones. Position: below the *Astragalus*, behind the *Cuboid*. Figure: longitudinal; a body and processes.

a. Body. Posterior termination, *proc. poster. s. calx*, heel, for the *tendo-Achillis*; inferior, narrow surface, with two tubercles; superior surface, with two convex articular surfaces, for the *Astragalus*; external surface, only covered

by skin, with two grooves, for the tendons of *peronæi*, and a tubercle before and above, important in a Surgical point of view, as a guide in *exarticulatio ped. Chopart*. Internal surface, deeply concave, forms with

b. *Process. intern. s. minor*, a blunt hook, projecting forwards and upwards, and having an articular surface, for *proc. anter. astrag.*, the *Sinus tarsi*, for the tendons, vessels, and nerves of the sole of the foot. Below it a *sulcus*, for the tendon *flex. halluc. long.*

c. *Process. ant. s. magnus*, represents the anterior surface of the *Corp. Calcanei*; has anteriorly an articular surface, for *os cuboid*; is externally rough, for *abduct. digit. 5*, and *extens. brevis*; internally a small process projects, *sustentaculum tali*.

b. Anterior row, consists of five bones, namely:—

3. *Os naviculare s. scaphoideum*. Position: on the same side as the great toe, before the *talus*, behind the three *cuneiform* bones, internal to the *Cuboid*. Figure: longitudinal, flat. Posterior surface, concave, for *Talus*; anterior, convex for the three *cuneiform* bones; superior, convex, free upon the back of the foot; at the internal extremity, *tuber. oss. navicularis*, for attachment of *m. Tibialis posticus*, perceptible through the skin; at the external termination a small articular surface, for the *os cuboideum*.

4, 5, 6. *Ossa cuneiformia*, three small, four-sided bones. Position: between *Navicular* and the three internal metatarsal bones.

I. *Os cuneiforme*, at the side of the foot, the largest; internal surface, beneath the skin; external, angular, for the second *cuneiform* and two metatarsal bones; posterior concave, for the *navicular*; anterior rather convex, for the first metatarsal; inferior, with *tuberculum*, for *m. tibialis anticus*.

II. *Os cuneiforme* lies between I. and II.; is the smallest, for the second *os metatarsi*.

III. *Os cuneiforme*, between II. and the *cuboid* bone, for the third *os metatarsi*, *m. adductor. halluc.*

7. *Os cuboideum*, Cube bone. Position: before the *calcis*, behind the fourth and fifth metatarsal bones, outside the *navicular* and *os cuneiforme III.*; on the outer, little toe, border. Superior surface, with *sulcus oss. cub.*, for the tendon of *m. peroneus long.* on the outer border. Inferior surface, with the *eminentia obliqua*, for *ligam. calcan.-cuboid*.

Development. *Calcis* and *Astragalus* ossify even in the sixth month of fœtal existence; the rest only in the first year after birth; but *Tuber calcanei* only in the tenth year.

107.

2. Metatarsus, middle foot,

consists of five columnar, parallel bones united like a grating with four *interstitia interossea*. Position: horizontal between tarsus and toes. Connection: behind with the three *cuneiform* and the *cuboid* bones; before with the first phalanges of the toes; with one another. Structure: the same as the long bones.

a. Posterior extremity. *Basis*, from the first to third metatarsal bone, corresponds with the three *cuneiform* bones; that of the fourth and fifth with the *cuboid*; with one posterior, for the *tarsus*, and two or one lateral articular surfaces for the *metatarsus*.

I. *Os metatarsi*, for *m. tibial. antic., flex. brevis, abduct. hallucis*, on the great toe border; very strong; the posterior, articular surface, for the first cuneiform bone, longitudinally concave, both lateral surfaces wanting; on the Plantar border, *tuberculum plantare*, for tendon of *Peronæus long.*

II. *Os metatarsi*, with three articular surfaces for the three cuneiform bones [two lateral, one posterior], and one for the third *os metatarsi*.

III. *Os metatarsi*; three articular surfaces, namely, one behind for third cuneiform, two lateral for second and third *os metatarsi*. III. and IV. for *m. adductor hallucis*.

V. *Os metatarsi*, for *peronæus 3, flex. brevis digiti 5*, with only one lateral articular surface for the IV. *os metatarsi*; and *tuberositas* on the free outer border, for *m. peronæus brevis s. Proc. triangularis* and *abductor digiti 5*, projects backwards and outwards, important in *exarticulatio metatarsi*.

b. Middle portion, *diaphysis*, for *m. interossei*; three-sided. Superior surface rather convex; internal and external meet below in the concave, plantar surface, at an acute angle. I. II., *os metatars.*, are the longest and strongest. V., flat and thick.

c. Anterior extremity, *capitulum*, with anterior, convex, articular surface, which is largest in the sole; and two lateral fossæ, sinus, and two tubercula, for *ligam. lateral.*

The first *os metatars.* projects into the sole of the foot, ball; and has two grooves, for *ossa sesamoidea*. IV. and V., for *caput breve m. transversal. pedis*.

Development of the metatarsus begins in the third fœtal month with one osseous nucleus in the centre piece, and with another at the *anterior* (in the *first os. metatars.* at the *posterior*) extremity in the second year, but only in the eighteenth year are the pieces completely united together.

108. *Digiti Pedis*, Toes,

five on each foot, each consisting of three, the great toe of two members, *phalanges*.

Phalanx I. the largest. Ph. II. small and short. Ph. III. Ungual, the smallest, flat. The posterior extremity, *basis*, of each phalanx is even, concave, for *capitul. metatarsi*. with *tubercula* on either side. The anterior extremity roller shaped, convex, with a sinus on either side; that of the third Ph. free, semilunar.

1. *Hallux*, great toe; two members; thick and large, less moveable than the fingers, on account of its strong ligament. To the plantar surface, *flexor brevis*, to the *basis* the first Phalanx.

2. *Ossa sesamoidea*, for abductor and adductor hallucis; Dorsal surface of first Phalanx, for *m. extensor hall. brevis*. To the *basis* the second Phalanx—one *os sesamoideum*:—Plantar surface, for *flex. hall. long.* Dorsal surface, for *extens. hall. longus*.

Second to fifth toes are always smaller.—First Ph., for *m. lumbricales*. Second Ph., for *flex. comm. brevis*. Third Ph., *basis*, for *flex. comm. long.* Dorsal surface of all three, for *extens. comm. long. and brevis*.

Fifth small toe, *Digitus minimus*. First Ph., *basis*, for *flex. brev. and abduct. digiti 5*.

Development. Two osseous nuclei, a. in the centre piece, at the end of the third foetal month; b. in the posterior end, *ext. halluc.* The second phalanx ossifies last. At birth the apex of the unguis phalanx is ossified.

109.

*Characteristics*of the *Male* andof the *Female* Skeleton.

Bones: stronger, larger, heavier, and more rough.

Head and extremities preponderating over the trunk.

Thorax: more elevated: anterior flattened; dorsal vertebræ higher; the ribs passing more obliquely downwards.

Sternum: longer and flatter.

Clavicles: more strongly curved, longer, inclined outwards; the angle with the sternum obtuse.

Abdominal vertebræ: shorter; and therefore the space, ventral cavity, between them and the chest is likewise shorter.

Pelvis: narrower, higher. *Promontorium* more pointed. *Crista iliaca* more sigmoidal and curved. *Arcus pubis*, angular. The *acetabula* closer to the axis of the body, therefore the gait less rolling.

Sacrum: narrower; *Coccyx* broader.

Extremities: longer, the inferior less converging.

Cranial and facial cavities, with exception of orbits, larger.

Canalis spinalis, narrower.

Shorter, thinner, lighter, and more smooth.

Trunk relatively larger than head and extremities.

Chest smaller, more barrel-like, farther removed from the pelvis; before roundish; dorsal vertebræ and ribs shorter; the last more horizontal.

Sternum shorter.

Clavicles straighter, more inclining outwards; the angle with the sternum almost a right angle.

Higher. Abdominal cavity more spacious.

Wider and shorter. Hip bones flatter, superior border standing more erect. *Symphysis* less elevated. Distance between it and the *Tuberositas*. *Ischii* greater; between it and the *acetabula*, *arcus pubis*, vaulted. *Foramen obturator*. triangular.

Broader; *Coccyx* narrower, more moveable, less projecting.

Shorter, the inferior converging to the knees; the *Trochanters* broad and more separated.

Mouth and nose, together with orbits, smaller; teeth smaller.

Canalis spinalis more spacious.

ARTHROLOGIA.

OF THE ARTICULAR EXTREMITIES OF THE BONES, AND THEIR
CONNECTION BY MEANS OF LIGAMENTS, FORMING JOINTS.

SYNDESMOLOGIA.

"In proportion indeed as we comprehend the principles of mechanics, or of hydraulics, as applicable to the animal machinery, we shall be satisfied of the perfection of the design."—*The Hand.* Sir C. BELL.

ARTHROLOGIA.

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110. OF THE LIGAMENTS.

In the union of the articular surfaces of bones three kinds of accessory organs are present which, in Syndesmology, are treated of in common, namely ligaments, synovial capsules, articular cartilage.

For a description of the manner in which the bones form joints, and the modes of their association, refer to page 30.

a. Ligaments of bones, *ligamenta*, συνδεσμοί, formed of firm and flexible fibrous tissue, consist of white and yellow fasciculi or cords which are not extensible and little sensitive, of a flat, longitudinal, oval, also annular or angular figure; they lie either between the bones, or on their external circumference, almost inseparably attached to the extremities which they unite together. We distinguish the following forms:—

1. Proper ligaments, *ligamenta fibrosa accessoria*, flat cords.
2. Fibrous capsules, *ligg. capsularia*, which are tendinous cylinders, attached by their openings to the bones, enclosing the Synovial capsules together with the Cartilages.

Yellow ligaments, *ligg. flava*, assigned to a particular purpose, do not belong to these tissues.

b. Synovial capsules, *capsulæ s. membranæ synoviales, articulares*, thin, translucent, closed sacs of serous uniting tissue between the articular extremities of the bones, connected externally with the surrounding ligaments, secreting inside a thin, serous fluid, or a thick, albuminous *Synovia*, drawing out into threads, which prevents the attrition of the bones upon one another. Folds which have lying between them small masses of fat, form internally the falsely so-called *Glandulæ Haversianæ*. The synovia is not secreted by them, but from innumerable blood-vessels, especially upon the lateral parts.

c. Articular cartilage, *cartilagine articulares*, are elastic discs of cartilage tissue which are present in all cases where joints exist, for the purpose of obviating or equalising the pressure of the bones upon one another. They are so much the thicker, the more moveable the articulation, particularly at the circumference of the articular cavity, but, in the *centre* upon convex surfaces. We distinguish:

1. *Cartilage* connected with the bones, which it is extremely difficult to separate from them, and the free surface of which looks into the articular cavity, and

2. Free articular cartilage, *cartilagg. interarticulares*, which on one of the two surfaces is connected with the articular end of the bones, is covered by the synovial sac, and connected on the borders with the fibrous capsule. They are from $\frac{1}{4}$ to $\frac{3}{4}$ of a line thick, and are only present in very moveable articu-

lations. They are named *Menisci*, $\mu\nu\nu$, from their Biconcavity. The cartilage may waste away by attrition.

3. Fibrous cartilages of the osseous joints, are generally disc-shaped, united closely with the Periosteum; for example, *symphysis pubis*, or annular *labra glenoidea* attached to the borders of the articular fossæ.

III. Connections of the *Vertebræ* with each other, *Articulatio vertebrarum*.

a. The vertebral bodies are united with each other by a close articulation, *amphiarthrosis*. The articular surfaces which are the superior and inferior surfaces of each vertebral body, are rather concave, do not immediately touch, but lie upon one another by means of:

1. The *ligg. (cartilagines) intervertebralia*, twenty three strong lenticular discs, consisting of concentric fibrous rings which, closer in the periphery, are separated towards the centre, the interspaces being filled by a yellow jelly, which, in the central point, becomes hardened into an elastic osseous nucleus. Their vertical diameter varies; it may, for example, diminish after standing long in the erect posture. In youth the gelatinous masses are softer and whiter than in old age, and on this account the vertebral column is less moveable in the latter than in the former. The vertebral bodies are further surrounded with a fibrous sheath, the

2. *Lig. longitudinale anterius*, on the anterior surface, from the *Tuberculum atlantis anticum* to the upper part of the *os Sacrum*; above narrow, below broad; white, membranous, thicker on the dorsal than upon the cervical and lumbar vertebræ; consists of two lateral portions, which are separated in the centre by a series of openings, for vessels. Below it mingles with the fibres of the crura of the Diaphragm and the Aponeurosis of the *m. psoas*; above with the tendons of the *m. long. colli* and *rectus*.

3. *Lig. longitud. posterius*, on the posterior surface, on the anterior of the *Canal. spinalis*, thicker and narrower than 2, commences upon the internal surface of the *pars basil. occip.*; the superior portion, from the third cervical vertebra, is particularly distinguished as *apparatus ligamentosus*, terminates in the *Canal. Sacralis*. The posterior surface is connected by processes with *Dura Mater*, the anterior with the *ligam. intervertebralia*. On the borders, passes *sinus venosi*, in the centre, between the ligament and the vertebral body, the *venæ vertebrales*. It extends, like the anterior, upon the intervertebral cartilages, and attaches itself firmly to them.

b. Connection of the *Processus obliqui*,—*Arthrodia*. The articular surfaces are covered with cartilage, provided with a synovial sac, and united together by *ligg. capsularia*.

c. Ligaments of the Vertebral arches:

Ligg. flava s. intercruralia, filling up the intervals between the arches, are, really, higher than these, thicker in the lumbar vertebræ, thickest in the region of the *Proc. spinosi*. Attachment: to the inferior and superior border of two vertebræ, as the one lies upon the other. Anterior surface smooth, separated from the *Dura Mater* by areolar tissue and *Vv. spinales*. Structure: thick, vertical, elastic but strong fibres. Use: to assist the Dorsal muscles in maintaining the erect posture of the body.

d. Ligaments of the Spinous processes:

1. *Ligg. interspinalia*, fill the spaces between the *Proc. spinosi*, are wanting in the neck, muscles existing there, are triangular on the Dorsal, thick and quadrangular on the Lumbar vertebræ.

2. *Ligg. apicum*, roundish, from the apex of the one to that of the next, *Proc. spinosus*; wanting in the neck.

3. *Lig. nuchæ*, cervical ligament, triangular, continuation of the *Ligg. apic.* upwards, from the seventh cervical vertebra to the *Spina Occipit. extern.*, receiving vertical elongations from the fissure between the *proc spinosi* of the superior cervical vertebræ.

e. Ligaments of the transverse processes, *ligg. intertransversalia*, are thin strips between the apices of the transverse processes, generally only on the Dorsal vert., placed here for the *m. levatores costarum et multif. spinæ*; very often double.

Movements of the Vertebral column: 1. Forwards [flexion]; 2. Backwards [extension]; 3. Inclination sideways; 4. Rotation. The cervical portion is the most, the dorsal the least moveable.

112. Connection of the Vertebral column with the Cranium, *Articulatio capitis.*

a. The Atlas with the Occiput:

1. Articular connection—*Ginglymus*—between *Proc. condyloidei occipitis* and *Proc. obliq. super. atlantis*, for the movements of the head, forwards and backwards, is maintained by:

Ligg. capsularia, particularly strong anteriorly and externally, broad, yellowish circles around the articular processes, between which a wide loose synovial capsule.

2. Ligaments:

α. *Ligam. obturatorium s. latum anterius*, strong and elastic, extends between the superior border of the Atlas and the *pars. basilar. occipit.*; before it in the centre lies

β. *Lig. rectum s. lacertus* (Weitbrecht) *medius*, a thick band, from *tuberc. antic. atlant.* to the *Proc. basilaris occipitis*, strengthening the before mentioned

γ. *Lig. obturatorium posterius*, thin, broad, and slack, from the posterior arch of the Atlas to the posterior circumference of the *foram. magn.*, laterally perforated by the *Art. vertebralis*.

δ. *Lig. laterale*, cord-like, from the *basis* of the *Proc. transvers. atlant.* to the *proc. jugular. occipit.*, forms with a similar from the *petrous bone*, a ring, for *vena jugular. intern.*, *Carotis intern.*, *n. Hypoglossus*, *vagus*, *glossopharyng.*, *access. Willisii*.

b. The *proc. dentiformis* with the occipital bone, only by ligaments.

1. *Ligg. lateralialia proc. dentiformis s. alaria Maucharti*, very strong and short, from the sides of the apex of the *odontoid process* outwards to a *fossa* on the inner side of each *Condyle*. They prevent too great lateral movement of the head.

2. *Lig. suspensorium dentis*, from the centre of the apex to the anterior border of the great foramen, it thus forms a figure like an inverted letter J, is quadrangular, and affixed to the *Odontoid process*.

113. c. The *Atlas* with the *Epistrophæus*, or *vert. dentata*.

1. Rotary articulation—*trochoides*—between the anterior arch of the *Atlas* and the *Odontoid process* which last describes on each side within a ring, anteriorly osseous, posteriorly ligamentous (*Lig. transvers.*), the fourth part of a circle, and prevents every other movement but rotation which is performed by the *proc. obliq. inferr. atlant.* and *superr. epistroph.*, as the atlas and cranium move thereon as one piece.

2. Between *proc. obliqui atlant.* and *epistrophæi* a free articulation—*arthrodia*—since the circular surfaces of both planes lie horizontal, and are provided with a wide articular and synovial capsule.

3. *Lig. transversum atlantis*, very thick and dense, flat, extending horizontally behind the *Odontoid process*, from one lateral mass of the atlas to the other. The anterior concave surface is in apposition with the posterior surface of the *Odontoid process*, which is covered with cartilage. [In the centre of this transverse ligament there is a portion of cartilage, and a very delicate synovial capsule is attached around the articular surfaces.] From the superior border an appendix passes upwards to the anterior border of the *foram. magnum*; a similar from the inferior border to the posterior surface of the *Corpus epistrophæi*; thence arises a *ligam. cruciatum*.

114. Articulation of the lower jaw, *articulatio maxillaris*, a free joint, formed

1. By the elongated *proc. condyloid.* of each half of the lower jaw, covered with cartilage, which is directed rather obliquely from without to within from before to behind; and

2. By the deep and capacious *fossa glenoidalis* of the temporal bones, the anterior part of which, to the *fissura Glaseri*, is alone covered with cartilage, and is an articular cavity. The anterior wall forms the convex transverse root of the *proc. zygomatic.*, and upon it the *proc. condyloid.*, likewise convex, rolls backwards and forwards.

Between the articular surface lies a free

1. *Meniscus* [or interarticular cartilage], firmly attached *below*, to the Condyle, *behind*, to the glenoid cavity, dividing the articular cavity into a *superior* and *inferior* space.

2. *Ligam. capsulare* extends from the border of the *fossa glenoid.* to the circumference of the Condyle. Above and below the cartilage lies a *synovial capsule*; the superior is wider, and proceeds from the boundary of the *Cavit. glenoid.* and *tuberc. articulare*, the inferior from *collum condyli*.

3. *Lig. laterale externum*, from the *tubercle* at the root of the *Proc. zygomat.* to the outer side of the *Collum Condyli*, triangular and broad; it covers the outer side of the joint.

4. *Lig. laterale internum*, from *Spina angularis* of the Sphenoid bone to the osseous lamellæ on the inner side of the *foram. maxill. post.*, separates the dental vessels and nerves from the *musc. pterygoid.*, is thin and broad, contributing little to the strength of the joint; likewise the so-called *Lig. stylo-maxillare*, merely fascia.

Movements of the lower jaw; *a.* downwards. The *condyles*, together with the *menisci*, roll from behind, forwards; *Ligam. later. extern.* is stretched; *Lig. lat. intern.* remains unchanged. Drawing down the lower jaw too strongly, as for example in gaping, may produce luxation, that is, a slipping of the *condyle* out of the *foss. glenoidal.* into the *zygomatic fossa.*

b. Upwards, that is, in closing the mouth. The movements of the condyle the reverse of *a.* Luxation backwards is prevented by the anterior wall of the auditory meatus, to which point the condyles may roll, for example, in edentulous old age.

c. Forwards (and backwards) horizontally: the articular head comes below the transverse root of the *proc. zygomat.* But it must be preceded by the movement downwards. All the ligaments are stretched. In too great extension the coronoid process is opposed by the upper jaw, and farther luxation rendered impossible.

d. From side to side. The condyle of one side passes sideways from its cavity, stretching its ligaments; that of the other sinks more deeply into its articular cavity, where a luxation inwards is prevented by *proc. styloideus* and its sheath, as well as by *proc. spinosus.*

The movements *c* and *d* are more limited than *a* and *b*.

115. Connections of the Thoracic cavity, Chest.

I. Vertebræ with the ribs, *Articul. costo-vertebralis.*

a. *Capitulum costæ* has a divided articular surface, which lies in the *foveæ costales*, formed by the bodies of two dorsal vertebræ, unites with the *cartil. intervertebr.*, and forms a free articulation, enarthrosis, not ginglymus. Its synovial capsule is single on the first, eleventh and twelfth ribs, double on the rest; articular capsule incomplete. Instead of it:

1. *Lig. capituli anterioris s. radiatum*, stellate on the anterior surface of the joint.

2. *Lig. capituli interarticulare*, on the second and to the tenth ribs, from the *crista* of *capituli* to the *cartil. interartic.*; flat, oval, and separating the two synovial capsules.

b. *Tuberculum costæ* has a convex articular surface which unites with one concave, on the *proc. transvers.* in a close joint. Moreover, ligaments pass from *collum costæ* to the *proc. transvers.*

1. Synovial capsule.

2. *Lig. tuberculi s. transversarium posterius*, quadrangular, behind the joint; from the *apex* of the *proc. transvers.* to the posterior surface of the *Tubercul. costæ* of the first to the tenth ribs inclusive.

3. *Lig. transversarium-intermedium*, from the anterior surface of the *proc. transv.* to the posterior of the *collum costæ*; very strong.

4. *Lig. transversarium internum*, rhombic, from the inferior border of the *proc. trans.* of the vertebra next above to the superior border of the *Collum*, wanting on the twelfth rib; divides the posterior and anterior branches of the Intercostal nerves.

5. *Lig. transversarium intern.*, triangular, weak, descends from the root of the *proc. transvers.* of the vertebra next above to the posterior surface of the *collum costæ*, close to the *capitulum*; it is wanting on the first, eleventh, and twelfth ribs.

116. II. The ribs with the sternum, *articulatio sterno-costalis*, Amphiarthrosis. The cartilages of the ribs which are firmly connected with the bone, and possess no farther external means of union than the common *Periosteum*, *Perichondrium*, are intimately attached in the *incisura. costal. sterni* by Synovial capsules and stellate ligaments, from the second to the seventh rib. The fifth to the ninth ribs have, at their place of contact, delicate synovial capsules. The first rib cartilage is, generally, closely united with the sternum.

Ligaments: 1. *Lig. interarticulare*, of the second to the fifth ribs, divides the double synovial capsules.

2. *Lig. radiatum externum*, proceeds from a true rib cartilage of one side to the one next above of the other, crosses also upon the centre of the Sternum, and loses itself in the Periosteum and the tendinous expansion of the great pectoral muscles. In a like manner is arranged the less strong *Lig. rad. intern.* upon the posterior surface of the Sternum.

3. *Ligg. coruscantia*, brilliant bundles of fibres between the third to the tenth rib cartilages, to fill up the spaces between the cartilages of the ribs. Vide *m. intercostales*.

4. *Ligg. processus ensiformis*, proceed from the inferior border of the sixth and seventh rib cartilages over the centre of the ensiform process and attach it to them.

5. *Membrana sterni propria*, covers the external and internal surface of the Sternum, and consists of the fibres of Periosteum crossing each other.

Movements of the chest.

1. *Expansion*, upon inspiration, by elevation of the ribs, whereby the anterior extremities of the ribs move forwards, the lateral outwards, and the diameter of the thorax is increased from before to behind and transversely. In forcible inspiration the Sternum also is elevated. The first rib remains immoveable.

2. *Contraction*, upon expiration, depends upon the falling back of the ribs and these parts, from their weight, and the elasticity of the cartilage, as well as in consequence of the direct action of the expiratory muscles.

117. Connections of the Pelvis.

a. The *Ossa coxarum* with each other. *Symphysis ossium pubis*. Pubic symphysis with:

1. *Lig. (s. cartilago) interosseum pubis*, a prismatic, fibro-cartilage, as on the bodies of the vertebræ, half an inch broad in front, covered by crossed fibres and by *Lig. pubis, s. arcuatum, superius*, transversely from one *tuberculum pubis* to the other.

2. *Lig. annulare*, consisting of transverse fibres, the rings passing round the borders of the articular surfaces.

3. *Lig. arcuatum inferius* s. *triangulare* or sub-pubic, beneath the symphysis, triangular, continuation of the *Lig. inteross.*, forms the superior border of the pubic arch; proceeds from one ramus descend. pub. to the other.

b. The *ram. coxarum* with the vertebral column, *symphysis sacro-iliaca*.

The articular surfaces of the Sacrum and Ilium, *superficies auriculares*, covered with cartilage and with a thin Synovial capsule, which in children and pregnant women is more distinct, are united by a slight layer of fibro-cartilage with gelatinous substance, and form an amphiarthrosis. Contributing to strengthen the articulation there are :

1. *Ligg. sacro-iliaca vasa anteriora*, short, transverse and oblique from the superior surface of the Sacrum to the internal of the Ilium, they blend with the *memb. oss. sacri propria*.

2. *Ligg. sacro-iliaca vasa posteriora*, short, crossed, filling up the fossa between the posterior surface of the Sacrum and *tuber oss. ilium*.

3. *Ligg. pelvis*, s. *ileo-sacra postica*, two; thick, on the posterior side of the pelvis;—*longum* arising from *spina ilei poster. super.*;—*breve* arising from *spina ilei post. infer.* Both are attached to the *proc. transversus* of the third and fourth sacral vertebræ. Sometimes three lateral bundles pass from the hip-bone to the *proc. transvers.* of the first and second sacral piece.

4. *Lig. ileo-lumbalia* s. *pelvis anterior*; lies over the *sacro-iliac symphysis*; springs from *proc. transv.* of the fifth or fourth lumbar vertebra. *Lig. superius* is fixed to the posterior part of the *crista Ilei*. *Lig. inferius* is attached broad upon the superior surface of the Sacrum and the internal of the Ilium, close to the *spina ilei poster. super.*

c. Of the sacrum and coccyx—a symphysis, which often ossifies; in very moveable coccyges, a synovial capsule. Between the articular surfaces a delicate layer of fibro-cartilage.—*Ligaments.*

1. *Ligg. sacro-coccygea postica longa*, from the border of the exit of the *Canalis sacralis*, which they close, diminishing upon the posterior surface of the coccyx, for *m. glutæi maximi*.

2. *Ligg. sacro-coccygea post. brevia*, below the last, passing from the cornua of the Sacrum to that of the coccyx; are often ossified.

3. *Ligg. sacro-coccygea antica*, from the apex of the sacrum to that of the coccyx, in front; often wanting.

4. *Membr. ossis sacri propria*, covers the anterior surface of the Sacrum, is above covered by *lig. longitudinale antierius*.

d. Ligaments for the purpose of limiting the pelvic cavity.

1. *Lig. obturatorium*, consists of aponeurotic bundles which cross in all directions, closing an egg-shaped opening; it is perforated at its superior margin by a foramen for *art., ven., nerv. obturator*, and serves to give attachment to the *m. obturatores externus et internus*.

2. *Ligg. sacro-ischiadica majus et minus*.

a. *Majus* s. *post. s. tuberoso-sacrum* arises from the internal lip of the *tuber*

ischii, and with a sickle-shaped extension, *falc. ligamentosa*, from *ramus ascendens oss. ischii*, by which arises a groove for *art., ven., et nerv. pudend. commun.*, and thus prevents pressure in the sitting posture; passes obliquely upwards and backwards, and is attached broad to the margin of the sacral, even to the most superior of the coccygeal, pieces; serves for the attachment of the *glutæus maximus*.

b. *Minus s. ant. s. spinoso-sacrum*, lies before *a*, springs from *spina Ischii*, passes inwards and backwards and blends with *a*; serves for the attachment of the *muscles levator ani, coccygeus*. From the manner in which the *Ligg. ischiad.* limit the *incisura ischiadica* below, two foramina arise, of which

1. The superior, *incisura major*, large, almost triangular, is in great part closed by the *mm. pyriformis et coccygeus*, together with areola or uniting tissue, and allows the passage through it of the *Nervi et vasa ischiadica, glutæa et pudenda*;

2. The inferior, *incisura minor*, small, between *spina et tuber Ischii*, for *m. obturator internus*. *Nerv. et vasa pudenda* also pass through it.

118. Connections of the Superior Extremities.

I. The Shoulder-bones.

A. Of the Clavicle with the Sternum, *Articul. Sterno-clavicularis*.

Arthrodia. The articular surface of the clavicle extends, before and behind, beyond that of the sternum, and the last, *incisura clavicularis manubrii*, likewise inwards and outwards over the clavicle. This bone is also firmly united with the first rib.

1. *Lig. capsulare*, round about the circumference of the two articular surfaces; before loose, therefore on this side displacement is more easy than behind; contains: an interarticular cartilage with an external loose and an internal synovial capsule, below, connected with the cartilage of the first rib, above and behind, with the *clavicula*.

2. *Lig. interclaviculare*, unites the internal extremity of one clavicle with that of the other, as it passes transversely over the *incisura semilunaris manubrii*, and indeed, lies rather behind it.

3. *Lig. costo-claviculare s. Rhomboideum*, a dense fibrous bundle; proceeds, obliquely backwards and upwards, from the superior margin of the first rib cartilage to the inferior and sternal end of the *clavicula*. An articular surface for the reception of the clavicula is, generally, present on the first costal cartilage.

The movements of the shoulder depend upon these articular connections.

a. Movement of the shoulder *upwards*. In this the sternal surface of the *clavicula* glides downwards, upon the articular surface of the sternum, the *Lig. interclav.* is relaxed; the cartilage of the first rib prevents the escape of the *clavicula* downwards.

b. Downwards.—The sternal end of the *clavicula* glides upwards; the articular surfaces of the clavicle and first rib are strongly pressed upon one another, whereby the *art. subclavia* is compressed.

c. *Backwards*.—The sternal extremity of the clavicle glides forwards; the anterior portion of the *Lig. capsulare* is stretched, often even to laceration, and then luxation of the clavicle takes place forwards.

d. *Forwards*.—The sternal end of the clavicle glides backwards; the posterior portion of the *Lig. capsulare* and of the *Lig. interclavicul.* stretched.

e. *In circumduction* the movement is very limited, and it is resigned to the upper arm.

119. B. Of the clavicle with the scapula, *Artic. acromioclavicularis*.

Amphiarthrosis.—The articular surfaces are elliptical, even, and lie obliquely to one another; that of the clavicle looks rather downwards and outwards, that of the *acromion* upwards and inwards; *above*, between them, but not always, we find a free cartilage, and a synovial capsule.

1. *Lig. capsulare (externum)* is attached closely with the following.

2. *Lig. claviculo-acromiale*, proceeds from the surface and the posterior border of the *acromion* to that of the external extremity of the clavicle; is above very strong.

Ligaments between *proc. coracoideus* and *clavicle artic. coraco-clavicularis*.

3. *Lig. posterius s. conoideum*, triangular, vertical from the root of the *coracoid process*, expanding as it ascends to the *tubercle* upon the posterior border of the external termination of the *Clavicle*.

4. *Lig. anterius s. trapezoidum*, oblique from the inferior border of the root of the *Proc. coracoid*, to the inferior surface of the *acromial* extremity of the *Clavicle*; close before 3.; both of them are loose.

Ligaments of the shoulder-blade.

1. *Lig. Coraco-acromiale*, is attached broad to the external border of the *Proc. coracoid*, and by an apex to the anterior blunt point of the *Acromion*, filling up the space between the two, and forming a roof over the upper arm.

2. *Lig. transversum*, thin, flat, passes from the root of the *Proc. coracoid*, across the *incisura scapulae*, with which it forms a foramen, for *nerv. suprascapularis et ven. trans. scap.*

120. II. Connection of *Scapula* with *Humerus*, *Artic. Scapulo-humeralis s. Artic. humeri*, Shoulder-joint,

is the most free of the whole body, the type of *Enarthrosis*.

a. Articular surfaces.

1. *Fossa glenoidalis*, superficial, concave, oval, directed outwards.

2. *Caput humeri* = $\frac{1}{3}$ of a sphere, the axis of which forms a very oblique angle with the *Corpus Humeri*. Both are covered with cartilage.

b. *Lig. s. labrum glenoideum*, a ring on the margin of, and for the purpose of deepening, the articular cavity which however does not enclose the entire articular head; consists of fibrous tissue. Vide Interarticular Cartilages.

c. *Lig. capsulare humeri*, from the margin of the articular cavity to the *Collum humeri* and the two *Tubercula*, forming a bridge over the groove between them and the tendon of the biceps; a loose spacious capsule which above has one to two openings, by which a communication is established between the synovial capsule of this joint and the *bursæ* of the *mm. infraspinal.* and *subscapular.* Is protected, below, in the axilla, by the arcular tissue between the tendons of the *mm. subscapular.* and *teres minor*;—above and externally by the tendons of the *m. supraspinatus*;—before, by the *m. subscapularis*;—behind, by the tendons of the *mm. supra-, infra-spinatus, teres minor*;—above, even strengthened by a *Lig. accessorium* of the *Proc. coracoid*, and by the tendon of the long head of the *Biceps* on the anterior aspect;—lastly, by the

d. Arch or vault, which is formed over the joint by the *acromion, Proc. coracoid., Lig. coraco-acromiale*, and *m. deltoideus*.

Movements:

1. *Forwards and backwards*.—The head of the humerus rolls upon its own axis. The escape of the head anteriorly is prevented by the *coracoid process*. The scapula performs at the same time a movement of rotation.

2. *Outwards*,—abduction.—The head of the humerus glides from above downwards, and presses upon the inferior portion of the capsule, the upper arm may even be conveyed to the skull; the scapula remains immoveable.

3. *Inwards*,—adduction.—The arms crossed over the chest.

4. Rotation outwards and backwards, inwards and forwards is of little extent.

121. Connection of the Upper with the Fore-arm, *Articul. cubito-humeralis*. Hinge-joint.

Articular surfaces.

a. Of the Humerus:

1. *Trochlea*.
2. *Rotula*.
3. *Fossa cubital. post.*, for *Olecranon*.
4. „ „ *ant.*, for *proc. Coronoid*.

b. Of the Fore-arm:

1. *Fossa sigmoid. ulnæ*, for the *trochlea*.
2. *Cavitas glenoid. radii*, for *rotula*.

Ligaments:

1. *Lig. capsulare cubiti* from the inferior extremity of the *Humerus* to the *Olecranon*, the *fossa sigmoid. major*, *proc. coronoid.*, and *lig. annulare radii*; loose and wide, behind and on the sides weaker than before; behind, the tendon of the *Triceps muscle*.

2. *Lig. laterale internum*, three portions from the *internal condyle* of the *humerus* to a point below the *Coronoid process* of the *Ulna* on the inner side.

3. *Lig. laterale externum*, triangular, from the *external condyle* to the *lig. annulare radii*, below the tendon of the *Supinator brevis*. The Synovial Capsule lies behind the anterior wall of the capsular ligament, reflected from the fossa anterior to the fossa posterior, where it is the widest; it terminates below in a blind prolongation on the inner margin of the *lig. annulare radii*.

Movements:

1. Flexion, *flexio*. The entire fore-arm moves upon the *Trochlea* and *rotula humeri* from behind, forwards, so that the finger-points may touch the mouth. *Proc. coronoid.* lies in the *fossa anterior*, and prevents farther flexion.

2. Extension, *extensio*.—The reverse of the preceding, from before backwards, until the axes of the fore-arm and humerus lie in the same line. *Proc. olecrani* lies in the *fossa posterior*, and prevents farther extension.

122. Connections of the Ulna with the Radius.

A. *Articulatio radio-cubitalis superior*.—*Rotatio*.

Articular surfaces:

1. On the *Radius*, *circumferentia articularis capituli*.

2. On the *Ulna*, *fossa sigmoidea minor*, elongated from before to behind, forms the osseous portion of the ring in which *Capitul. radii* rolls.

Ligaments: 1. *Lig. annulare radii*, strong, dense, three-fourths of a ring, surrounds a synovial capsule and *capitul. radii*; attaches itself to the anterior and posterior extremity of the *fossa sigmoid. minor* and unites externally with *lig. laterale externum*; above, with *lig. capsulare cubiti*; is anteriorly much thinner, and therefore easily lacerates.

2. *Lig. teres s. chorda transversalis cubiti*, Weitbrecht, passes obliquely from below, outwards, from the most external aspect of the *Proc. Coronoid.* to the inferior portion of the *Tuberosit. (bicipit.) radii*; compensates for the *lig. interosseum* at the superior part.

122. bis. B. *Articulatio radio-cubitalis inferior*.—*Rotatio*.

Articular surfaces:

1. On the *radius*: *incisura ulnaris*.

2. On the *ulna*: *capitulum*, $\frac{2}{3}$ of the external circumference.

Ligaments: 1. *Lig. capsulare sacciforme*, broad and loose, proceeds from the

boundary of the *incisura semilunaris* to that of the *Capitulum Ulnæ* and the *Cartilago triangularis*; lies beneath *lig. capsulare carpi et antibrachii*.

2. *Cartilago-triangularis* lies with its apex in the angle between *Capitul. et Proc. styloideus ulnæ*, with its base on the inferior border of the *incisura semilunaris*, and fills up the interval between the two bones; its apex, *lig. subcrurum*, unites with the *proc. styloid. Ulnæ*; over it a synovial capsule.

Appendant: 3. *Lig. interosseum*. A membrane in the space between the central pieces of the *radius* and the *ulna*, from the *Crista radii* to the *Crista ulnæ*; serves for attachment of muscles, *extensor brevis*, *abductor* and *flexor longus pollicis*, *extensor indicis proprius*, *flexor digit. comm. profund.*; has above and below spaces through which the *interosseal vessels and nerves* perforate, and for *m. supinator brevis*. The fibres of the ligament cross from the *radius* inwards and downwards.

Movements:

Rotation; the *radius* alone moves. 1. Forwards,—*pronation*. a. At the *superior radio-ulnar articulation*. The internal portion of the *capitul. radii* rolls from before backwards; its escape is prevented by the small projection on the *foss. sigmoid. min.*; but, however, it sometimes happens, particularly in children while falling, at the same time that the hand is held. b. At the *inferior radio-ulna art.* The *fossa semilunaris radii* rolls backwards and forwards; should the capsular ligament lacerate, the *capitulum ulnæ* passes out backwards.

2. Backwards,—*Supination*. a. At the superior articulation: The *capit. radii* rolls from behind, forwards, and comes in contact with the anterior projection of the *Fossa sigmoidea minor*. Luxation is very rare. b. At the inferior articulation: *Fossa semilunaris radii* rolls from before, backwards; the *capitulum ulnæ* may escape forwards, if the capsular ligament is lacerated.

In *pronation* the once parallel body of the *radius* is drawn over the *ulna*, and crosses it, since the superior extremity remains on the outer side, and the inferior passes to the inner. The *interosseous ligament* is relaxed.

In *supination* the *radius* returns back again into its parallel position, with respect to the *ulna*, and the *ligam. interosseum* is stretched.

123. V. Connection of the Fore-arm with the Hand, *Articulatio carpi.*

The wrist-joint, *articulatio carpi*, forms a free, ball and socket joint.

Articular surfaces: 1. Of the *radius* and *ulna*, concave, elongated transversely. 2. Of the carpus—*os. naviculare*, *lunatum*, et *cuneiforme*—forming a head.

That portion of the articular surface, belonging to the *Ulna*,

contributes only $\frac{1}{3}$ to the whole, and unites with the *os. cuneiforme* by the *cartilago-triangular* (vide *antè*), but not immediately. On both sides of the articular surface of the fore-arm we find *proc. styloidei*.

Ligaments: 1. *Lig. capsulare antibrachio-carpalis*, Günther, before much stronger than behind, covers the *lig. capsul. saciforme* (vide *antè*). Attachments: the Dorsal surface of the *radius* and *Cartil. triangul.* The Dorsal surfaces of the *three carpal bones*. This is strengthened by *lig. rhomboideum s. radio-lunato-hamatum dorsale*; on the palmar surface completed by ligaments, which pass from the *radius* to *os lunatum, naviculare*, and *proc. styloid. ulnæ*.

2. *Lig. laterale externum*, from the apex of the *Proc. styloid. radii*, broad to the outer border of the *Os naviculare*; strengthens the capsular ligament.

3. *Lig. laterale internum*, from the apex of the *Proc. styloid. ulnæ*, roundish, with one portion for the *Os pisiforme*, the other for the *os triquetrum*.

The synovial capsule is loose *posteriorly*. Of the interarticular cartilage or *lig. triangulare*, vide *antè*.

Movements: 1. *Flexion*.—The three carpal bones glide from *before, backwards*; the posterior capsular ligament and the tendons of the extensor muscles are stretched.

2. *Extension*.—The three carpal bones glide from *behind forwards*. The anterior capsular ligament and the *Ligg. lateralia* are stretched, and prevent too great extension.

3. *Abduction*.—The *radial* border of the hand is directed towards that of the fore-arm; *Proc. Styloid. et extern. oss. navicul.* prevents farther movement.

4. *Adduction*.—The *Ulna* border of the hand inclines to that of the fore-arm; *Proc. styloid. ulnæ* upon *os triquetrum*. Luxation is difficult and, always, only incomplete.

124. VI. Connection of the Carpal Bones, *Amphiarthrosis*.

The articular surfaces of the carpal bones of the first row are oblique, those of the second row vertical.

Ligaments: a. *Ligg. interossea*, 1. Those of the first row are small fibrous bundles between the articular surfaces; of a reddish color. 2. Of the second row, thicker and closer, on the entire surface of the bones.

b. *Ligg. volaria*, thicker than

c. *Ligg. dorsalia*.—Both pass transversely or obliquely from the one carpal bone to the other.

Os pisiforme is united by *lig. capsulare* and two *ligg. lateralia* with the *os cuneiforme* by the *lig. inferius externum* with *Proc. unciiform. oss. hamati*, by *lig. inferius internum* with *os metacarpi V*.

125. VII. Connection of the two rows of the Carpal Bones, *Articul. carpo-carpalis*.

Os capitatum and *Os hamatum* of the *second row* form together an articular head, which sinks into an articular cavity formed by

Os naviculare, lunatum et cuneiforme of the first row, thus forming a Ginglymus joint.

Ligaments: 1. *Lig. capsulare commune*, passes from the first row, *os pisiforme* excepted, to the second row; is more dense before than behind.

2. *Lig. volare* from *os Cuneiforme* and *Naviculare* to *Os capitat.* or *Magnum* and *Trapezium*.

3. *Lig. dorsale* from the first row, *os pisiforme* excepted, to the whole of the second row.

4. *Lig. laterale externum* s. *radiale*, from *os naviculare* to *os trapezium*.

5. *Lig. laterale internum* s. *ulnare*, from *os cuneiforme* to *os unciforme*.

A single synovial capsule lies between the two rows of carpal bones, with two superior and three inferior small blind extensions in the spaces between the separate bones.

[*Ligg. Glenoid.* (Cruveilhier) increase the depth of the articular cavities.]

Movements. The separate bones move scarcely, or not at all, upon one another; but between the first and second row the following movements exist:—

1. Extension, tolerably limited, as the strong anterior ligaments prevent it.

2. Flexion, and indeed to such an extent, that the *os magnum* may be dislocated backwards; flexion of the hand takes place in great degree through this articulation, more than by the *artic. carpo-radialis*.

126. VIII. Connection of the Carpal with the Metacarpal Bones, *Articul. carpo-metacarpea*.

The inferior surfaces of the second to the fourth carpal bones of the second row, and the superior of the second to the fifth metacarpal bones, are attached angularly to one another, and thus form an immoveable articulation, whilst the *os I. metacarpi*, thumb, is united in a free articulation, moving in all directions, with the *os trapezium*.—Ligaments: upon the dorsal and palmar surfaces are short and strong.

1. *Os metacarpi II.* has three ligg. dorsalia; a. *externum* to *os trapezium*: b. *medium* to *os trapezoid*; c. *internum* to *os magnum*.

2. *Os metacarp. III.* has two ligg. dorsalia: a. *rectum* to *os magnum*; b. *obliquum* to *os unciforme*.

3. *Os metacarp. IV.* has one lig. dorsale to *os trapezium*; longer and looser than 1. and 2.

4. *Os metacarp. I.*, thumb, has *lig. capsulare*, a loose, large ligament, which passes from *os trapezium* to

1. *Ligg. volaria* 2. *sublimi et profundum* to *trapezium*.

2. *Ligg. vol.* 3. *externum* to *os trapezium*; *medium* to *os magnum*; *internum* to *os unciforme*.

3. *Lig. vol.* 1., to *os unciforme*.

4. *Os metacarp. V.* has *lig. capsulare*, incomplete, much stronger before than behind, where the tendon of

os metacarp. I., a synovial capsule to itself, behind, assisted by *m. extens. poll.*, outside, by *m. abduct. long.*, inside, *m. interossei* and *art. rad.*; has close to it anteriorly *m. pollic. minores*.

m. extens. ulnæ protects it, and unites with *os unciniforme*. Its synovial capsule belongs equally to the *os metacarp. IV.*

NOTE. Günther (d. Handgelenk, &c.) enumerates ninety ligaments in the articulations of the hand.

Movements: of *os metacarp. I.*: 1. *Flexion*, obliquely inwards and forwards, approximates the thumb to the *fifth os metacarp. (oppositio)*, and may cause luxation backwards.

2. *Extension*, goes so far, that upon the outer side almost a right angle is formed between *os. metacarp. I.* and the radius; luxation is prevented by the dense posterior portion of the capsular ligament.

3. *Abduction*, the thumb is removed directly outwards from *os. metacarp. II.*: it may give rise to luxation inwards.

4. *Adduction* is limited by *os metacarp. II.*

127. IX. The heads of the Metacarpal Bones,

of the second to the fifth are united together by *lig. transversum*, (*volare*), which passes from one to another like a bridge, lying below the tendinous sheaths of the *m. flexor digit.*, and serving for the attachment of the *m. lumbricales*. The central portions of the *ossa metacarp.* are maintained in their situation by *ligg. interossea*.

128. X. Connections of the Fingers.

A. With the metacarpal bones.—Free, ball and socket articulation; that of the thumb, *Ginglymus*. Articular surfaces: on the metacarpus—even, like a head, oval from behind, forwards. On the first phalanx—smooth fossa, oval transversely.

Ligaments: 1. *Lig. antierius s. transversum*, very strong and dense on the palmar surfaces of the second to the fifth fingers, filling up the articular cavity; connected with the tendinous sheaths of the *mm. flexores*, above very loose on the *Collum capituli oss. metacarp.*

2. *Ligg. lateralia*, very strong, passing obliquely from behind forwards, and from above downwards, from *tubercul. oss. metacarp.* to the *lig. antierius* of either side. On the dorsal surface the tendinous sheath of the *m. extensor*. takes the place of ligament. [There is, however, a thin delicate capsule.] In the *lig. antierius oss. metacarp. I.* are placed two *ossa sesamoidea*.

Movements: 1. *Flexion* the most marked, especially in the first, fourth, and fifth joint. The finger can describe a right angle with the centre of the hand. Flexion is limited by the posterior fibres of the *lig. lateralia*.

2. Extension, to the extent of an obtuse angle, is restrained by the ring which *Lig. anteriur* and the anterior fibres of *Ligg. lateral* form. In too violent extension the *Capitul. os. metacarp.* passes over the ring or tears it, and dislocation of the finger backwards arises, which can only be reduced, if the ring is actually lacerated, but is prevented if it is pushed between the articular surfaces.

3. Abduction and Adduction.

B. The phalanges with each other—*Ginglymus*. Articular surfaces: a. At the inferior extremity of the I. phalanx—a trochlea with two small condyles. b. At the superior extremity of phalanx I. and II.,—two small fossæ.

Ligaments: 1. *Ligg. capsularia*, on the dorsal surface loose and thin, and formed even here of the fibres of the tendinous sheaths of *mm. extensor.*, the rest like the *lig. ant.*, as in A.

2. *Ligg. lateral ext. et. int.*, as in A.

3. *Capsulæ synoviales*, in A and B are, especially on the dorsal surface, very loose, not connected with the tendons, stretch in flexion, and fold up in extension.

Movements: Flexion. That of the second phalanx is more marked than that of the third.

Extension is much more restrained than in the metacarpo-phalangeal articulation. Lateral motion is not possible.

129. Connections of the Inferior Extremities.

I. Of the Thigh with the Pelvis, *Articulatio coxæ*, hip-joint.

Articular surfaces: Head of the femur and acetabulum, united in a ball and socket joint, not admitting air, less moveable, but stronger than the shoulder joint.

Ligaments: 1. *Labrum cartilagineum acetabuli*, a fibrous ring, of four lines thick, encircling the edge of the acetabulum, which it deepens, passes over the *incisura acetabuli* below and before, as *lig. transvers. acetabuli*, and thus forms the *foram. acetabuli*, for the vessels of the joint; is thicker above and behind; narrower at its free than at its attached border. Consists entirely of fibrous tissue. See *Interarticular Cartilage*.

2. *Ligam. capsulare femoris*, passes from the border of the bony acetabulum in front, to the *linea intertrochanter. anter.*; behind, as far downwards as the centre of the neck of the femur; is of a dull white hue, composed of crossed fibres, two lines thick, strong, solid, and looser at the sides; above and externally, beneath the tendon of the *m. rectus femoris*, thicker; is strengthened by a bundle of fibres, the *Zona orbicularis* seu *lig. anteriur superiur*, which passes obliquely from *Spina ilei anter. infer.* to the inner part of the *basis colli femoris*, around this anteriorly and back to the *Spina*. Anteriorly, the fibres of the *m. Psoas* and *Iliacus*, and their synovial sheaths are attached to it. Internally are situated the *m. obturator extern. et pectineus*; externally *gluteus minimus*; behind *quadratus femor.*; *bigemini*, *pyramidalis obturator internus*.

3. *Lig. teres femoris*, one inch long. passes from the *fovea pro. lig. terete* upon the head of the femur, becoming broader in its course and dividing to be attached to the *fovea acetabuli*. It lies between the two articular surfaces, is sometimes very thin and even wanting.

The synovial capsule lies inside the *lig. capsulare*, lines it, the neck of the femur, the articular surfaces, the *lig. teres*, and is generally in connection on the inner side of the *Zona orbic.*, perforating the capsular ligament, with the *bursa iliaca*, which is the bursal sac of the *flexor femoris*.

Movements: 1. Flexion, the thigh brought forwards: the head of the femur rolls from before backwards in the acetabulum. In consequence of the oblique position of the neck of the femur, it is possible for the knee to touch the shoulder.

2. Extension: this backward movement is limited by the posterior portion of the neck of the femur striking against the edge of the acetabulum, and the head is supported in its movement forwards by the *Zona orbicularis* and *m. psoas et iliacus*.

3. Abduction, the limb directed outwards. The head presses against the internal relaxed portion of the *Lig. capsul.*; and this, the *lig. teres*, and the meeting of the upper part of the neck of the femur, and the edge of the acetabulum, prevents its escape.

4. Adduction: one thigh approaches the other, and may cross it with the assistance of slight flexion. The depth of the acetabulum and the strength of the capsular ligament above and externally prevent the escape of the head upon this side. The *Lig. teres* stretches; it is torn in the dislocation of the thigh, so frequent in this situation, from a fall upon the knee, &c.

5. Rotation: The internal portion of the head of the thigh moves horizontally forwards, the anterior of the shaft outwards; and the reverse. Rotation is impossible in fracture of the neck of the femur.

130. II. Of the Thigh with the Leg Bone, *Articulatio genu*, Knee-joint.

Ginglymus. Articular surfaces: 1. On the *femur*, two roller-like condyles, between which is a deep fossa; 2. On the *tibia*,—in the centre the *eminentia media*, on the sides fossæ, for the condyles; 3. *Patella*,—in the centre a vertical elevation, which lies anteriorly in the *Incissura inter-condyloidea oss. femor.* All the articular surfaces are smooth and covered with cartilage. In addition:

Cartilagine semilunares, two sickle-shaped cartilages, which lie between the *Condyl. oss. femoris et tibiæ*, and are connected together by a delicate *lig. transvers.* Their external border is thick, the internal sharp, the anterior and posterior cornua thin; by these the fossæ, close to the *eminentia tibiæ*, are deepened. The *external*, smaller, almost crescentic cartilage, nearly covers the entire fossa. Its cornua are attached between the two tubercles of the

eminentia media. Posteriorly a thick fibrous band passes from it around the *lig. cruciat. postic.*, and is attached behind this to the *condyl. extern. femoris*. The internal cartilage is larger, does not so much cover the fossa; attaches itself by the cornua before and behind the projections of the *eminent. media*; the posterior cornu is covered by the *lig. cruciat. postic.*

Ligaments: 1. *Lig. capsulare genu*, large and loose, weakest in front and at the sides, behind united with *lig. popliteum*; passes off from the superior borders of the *Condyl. femor.* to the circumference of the articular surfaces of the *Tibia* and the posterior of the *Patella*, behind *lig. Patellæ*.

2. *Lig. popliteum* [the posterior ligament of Winslow], oblique from *Condyl. extern. femoris* to the internal border of the *Condyl. internus tibiæ*; strong, flat.

3. *Lig. Patellæ*, a portion of *tendo comm. extensorius*, thick, almost triangular, broad at the apex of the *Patella*, narrower at the inferior part, the *tuberosit. tibiæ*.

4. *Ligg. lateral. genu*. a. *externum*, round, tendon like, lies before and between the two heads of the *m. biceps fem.*; from *condyl. extern. fem.* to the outer portion of the *capit. fibulæ*; *extern. breve* lies behind a, and is attached higher up to *capit. fib.* b. *internum*, broad and thin, from the posterior portion of *condyl. intern. femor.* to the *condyl. intern. tibiæ*, is below covered by the tendons of the *Pes anserinus* (see Myology), and connected with the *Cartil. semilunar. intern.* Both lie rather posteriorly behind the centre of motion of the joint, are slackened in flexion and limit extension.

5. *Ligg. cruciata s. interossea*, crossed like the capital letter X between the articular surfaces of *oss. femor. et tibiæ*, in the *Incisura intercondyloidea*.

a. *Lig. cruciat. anticum*, passes from the posterior internal surface of the *Condyl. extern.* to the most anterior portion of the *eminentia media tibiæ*; behind it the longer and thicker (b), *lig. cruciat. posticum*; from the anterior inner surface of *Condyl. intern.* to the posterior extremity of the *eminentia media*. It is connected with the *Cartil. semilun. externa*; it slackens under extension, and stretches in flexion of the joint, whilst the *Lig. antic.* is slackened in flexion.

A synovial capsule is very distinct; a shut sac lies above between *tendo extensor et femur*; at the sides of the patella, on the inner side especially, beneath the *m. vastus internus*, the *ligg. alaria* which blend behind with a fibrous fold, *Lig. mucosum s. adiposum*. It invests the whole internal surface of the capsular ligament, the two surfaces of the *Cartilagg. semilunares*, and envelopes the *lig. cruciata*. Between it and the *lig. patellæ* much fat is found, as well as about the *ligg. cruciata*, and chiefly in the *incis. intercondyl.*

Movements: 1. Flexion. The heel may touch the thigh. The posterior, lateral, and posterior crucial ligaments are relaxed, the ligament of the patella is stretched, and the bone is fixed, in front of the space between the femur and tibia.

2. Extension. The articular surfaces of the tibia with the *cartil. semilunar.* roll from behind forwards, until the thigh and leg lie in the same line. *Lig. patellæ* and *cruciat. anticum* are relaxed, the rest become stretched. The *Patella* may be displaced.

3. Rotation, inwards and outwards, is very limited, and is only performed by the *condylus internus*. It is effected, *outwards*, by the action of the *m. biceps fem.*; *inwards*, by the *m. popliteus*.

131. *Connection of the Tibia and Fibula.*

A. Superior, *Articul. tibio-fibularis superior*—is immovable. The articular surface of the *tibia*, at the posterior part of the *Condyl. extern. tibiæ*, looks downwards and outwards; that of the *fibula* at the internal part of the superior extremity, upwards and inwards.

Ligaments: 1. *Lig. capsulare capit. fibulæ*, passes obliquely outwards and downwards from the border of the articular surface of the *Condyl. extern. tib.* to the *Capitul. fibulæ*; it is short and strong.

B. Inferior, *Articul. tibio-fibular. inferior*—likewise immovable. The articular surfaces are only in part grasped by one another, and in other parts a strong interosseous ligament fills the space between them. The synovial capsule belongs partly to the tarsal joint.

Malleolar ligaments: 1. *Lig. tibio-fibul. anticum*, between the anterior tubercle of the *Incis. peronæa tibiæ* and that of the *Malleolus extern. (fibulæ)*.

2. *Lig. tibio-fibul. post.*, between the posterior tubercles of the same parts.

Both divide into a superior and inferior fasciculus, pass obliquely from above to below, and from within to without, and project beyond the articular surfaces.

C. Central, *Membrana interossea cruris*, stretched in the interspace between the *tibia* and *fibula*, it separates the anterior from the posterior muscles of the leg; *above* it is broader than *below*; externally and above, it has an opening for the *Vasa tibial. antica*; below, it is perforated by the *Vasa peronæalia*. Its fibres are directed obliquely from within, outwards and downwards. Anteriorly are attached to it: *mm. extensores hallucis et digitorum commun. longus*; behind, *m. tibialis posticus, flex. digit. commun. longus*.

132. *Connection of the Foot with the Leg. Artic. pedis s. tibio-tarsalis.*

The ankle joint is a ginglymus; that is to say, it consists of a roller which moves forwards and backwards in a depression on the tibia.

Articular surfaces: 1. On the leg (*tibia* and *fibula*), a fossa divided into two halves by a projection, bounded laterally by the malleoli. 2. On the foot (*talus*), a roller, with lateral articular surfaces, for the malleoli.

Ligaments: a. *Ligg. lateralia externa s. fibularia*, three, passing from the *fibula* either to the *Talus* or *Calcaneus*.

1. *Fibulare calcanei s. perpendiculare medium*, roundish, under the sheaths of the peronæi muscles, passes from the apex of the *Malleolus extern.* to the outer side of the *os calcis*.

2. *Fibulare astragali anticum*, very short, from the anterior border of the *Mall. extern.* to the *Astragalus*, below broader.

3. *Fibulare astragali posticum*, close upon the capsule, almost horizontal, from the fossa within and behind on the *malleolus* to the posterior border of the *Talus* or *Astragalus*.

b. *Lig. laterale internum* s. *tibiale*, stronger than the anterior, consisting of two layers;

1. *Superficiale* s. *delloideum*, from the apex and the anterior and posterior border of the *malleolus intern.* to the *calcaneus* and *lig. calcaneo-naviculare*; the most anterior fibres, that is, *lig. later. intern. anterius*, a thin layer, passes directly forwards to the *collum astragal.* and *os navicul.*

2. *Profundum*, below this, stronger, outwards and downwards; from the apex and the borders of the *malleolus* to the internal part of the *Talus*, below the articular surface.

The Synovial capsule is very loose anteriorly, and covered with fat.

Movements: 1. *Flexion.* The *Talus* glides from before, backwards; the *Collum tali* meets the anterior border of the articular fossa, so that dislocation is scarcely possible. The dorsum of the foot moves upwards and backwards.

2. *Extension:* *Talus* glides from behind, forwards. Displacement is rare. The dorsum of the foot moves downwards and forwards. Lateral motion does not take place in this, but in the tarsal joints.

133. Connection of the Tarsus, *Artic. tarsi.*

I. The first row, that is, *Talus* and *Calcaneus*, are united in a limited *Arthrodia*, by which the lateral movements of the foot are performed.

Articular surfaces: On the inferior surfaces of the *Talus* an anterior convex and a posterior concave. On the superior surface of the *calcaneus*, a posterior convex and an anterior concave.

Ligaments: 1. *Lig. inteross.* (s. *Apparat. ligamentosus sinus tarsi*), strong.

2. *Lig. capsulare astragalo-calcaneum* (Synovial capsule), thin; internally strengthened by the fibrous sheaths for the tendons of the *M. tibialis post., flex. digitor. comm.*, and *propr. hallucis*; anteriorly and posteriorly, by small bundles of fibres.

134. II. The second row, namely,

Ossa cuneiformia, three in number, *naviculare* and *cuboideum*, are united in close articulations, *amphiarthroses*, with one another.

a. *Os naviculare* unites anteriorly with the three *cuneiform* bones by an articular surface divided into three facettes, each of which is triangular. The ligaments are:

1. *Lig. dorsalia*, two for the *Os cuneiforme I.*, straight from before to behind; one for each of the two others, passing obliquely forwards and outwards.

2. *Ligg. plantaria*. Those of the second and third cuneiform bones are indistinct; on the contrary, that of the first very strong, from *tuberc. oss. navicul.* to that of the *cuneiforme I.*; losing itself in the tendon of the *m. tibialis anticus*, which is extended to the *Os cuneiforme III.* and *Os metatars. III.*, and forms *lig. tarsi inferius*.

b. *Ossa cuneiformia* are united together by very firm transverse

1. *Ligg. dorsalia*; connected above with the *mm. extensores digitor.*; below, with the periosteum.

2. *Ligg. interossea*, very strong, and firmly attached.

c. *Os cuneiforme III.* and *os cuboideum* are united by very strong transverse

1. *Lig. dorsale*.

2. *Lig. interosseum*, around the articular surface.

3. *Lig. plantare*, thin.

d. *Os naviculare* and *os cuboideum* united by

1. An oblique *Lig. dorsale*.

2. *Lig. interosseum*.

3. *Lig. plantare*, very thick, transverse from *tuberc. oss. navicul.* to the *os cuboideum*.

135. III. Connection of the first with the second row.

a. *Talus* and *os naviculare*. The fossa of the *navicular* bone, in which the head of the *talus* is received, is deepened by

1. *Lig. calcaneo-naviculare inferius (plantare)*; it forms the internal portion, and lies in the triangular space between *proc. minor. calcan.* and *os naviculare*; consists sometimes of an internal and external portion, the last round and cartilaginous; is sometimes represented by a thin, osseous plate from the calcis, so that the *Calcaneus* and *os naviculare* come into immediate contact.

2. *Lig. Calcaneo-naviculare superius (dorsale)*, from the internal side of the anterior extremity of the *Calcaneus* to the external of the *os naviculare*; in the deep hollow on the outside of the *Talus*, which is filled with fat.

The *talus* is also firmly united with the *os naviculare*, by means of the *calcaneus* only, but it may, by strong concussion, escape from its connection. Its own ligament is weak, namely:

3. *Lig. astragalo-naviculare superius*, from *Collum tali* to the circumference of the articular surface of *Os naviculare*; above, covered by *m. extens. digitor. brevis*; semicircular.

b. *Calcaneus* and *os cuboideum*, the articular surfaces reciprocally coincide. Tubercle on the *Calcaneus*, important in Amputation:

Ligaments: 1. *Lig. calcaneo-cuboideum plantare*, the strongest of the tarsal ligaments; passing from the entire inferior surface of the *Calcaneus* to the posterior of the *Os cuboid.*, it may be divided into a superficial and deep.

2. *Lig. calc.-cub. internum*, short, narrow, strong, in the fossa between *talus*

and *calcaneus*, describing with the *lig. calc. navicul. superius* a figure like the capital letter Y; after their division, the two rows of tarsal bones separate from each other.

3. *Lig. calc.-cub. superius*, thin, small, from *Calcaneus* to *os cuboideum*.

Movements: Adduction and Abduction, whereby the sole of the foot is turned inwards or outwards, arising by *talus* and *calcaneus* on one, *os naviculare* and *cuboideum* on the other side, assisted by slight lateral movement between *talus* and *calcaneus*.

136. Connection of the Metatarsal Bones, *Artic. metatarsi.*

These bones are united with those of the tarsus and with one another by close articulations.

137. A. With the tarsus. 1. The tarsal extremity angular, with even articular surfaces. That of the third metatarsal bone makes an angle, forwards, with the line of the rest.

a. *Os metatarsi I.* 1. *Lig. plantare*, stronger than the *Lig. dorsale*, with synovial capsule. 2. Aponeurosis of the tendon of *m. peronæus long.* to the *os cuneiforme I.* 3. Aponeurosis of the tendon of *m. tibialis anticus* to the *Os metatarsi I.*

b. *Os metatars. II.* 1. *Lig. plantaria*, two from the second cuneiform, the third from first cuneiform bone, lateral. 2. *Lig. dorsalia*, three; *a. internum* from first cuneiform; *β. externum* from third cuneiform, thin; *γ. medium* from second cuneiform.

c. *Os metatars. III.* 1. *Lig. dorsale* from third cuneiform. 2. *Lig. plantare*, very thin; instead, the tendon of *m. peronæus long.* 3. *Lig. laterale extern. seu interosseum.*

d. and e. *Oss. metatars. IV. and V.* 1. *Lig. interossea*, very strong. 2. *Lig. dorsale* and *lig. obliquum*, on *oss. metatars. V.*, very loose. Instead of *Lig. plantare*, the tendon of the muscles *peron. long.* and *tibial. posticus*.

138. B. The posterior extremities with each other. *Ligg. baseos ossium metatarsi.*

1. *Ligg. dorsalia.* 2. *plantaria*, stronger. Transverse from the one to the other bone.

3. *Ligg. interossea*, strong, short, and thick, between the rough, lateral surfaces, are wanting between the first and second *os metatars.*

139. C. The anterior extremities. No articular surfaces, but synovial capsules; rather moveable on one another.

1. *Lig. transversum s. capitulorum oss. metatarsi*, on the sole between the heads, below the sheaths of the tendons of the flexor muscles; loose.

Movement: indistinct.—*Os Metatars. I.*, of great toe, is not more moveable than the rest.

140. Connection of the toes, *Artic. digitorum pedis*.

a. Of the metatarsal bones with the toes, by ball articulation ;
b. Of the phalanges with each other, by Ginglymus. On the first phalanx of the great toe a double pulley with *ossa sesamoidea*.

1. *Lig. capsularia*, very thick, cartilaginous in the sole, where is a groove for *mm. flexores*, very thin on dorsum, strengthened by tendons of extensor muscles, beneath which is a loose synovial capsule.

2. *Ligg. lateralia*, very strong, from the capsular ligaments obliquely to the *tubercula* behind the head of the *oss. metatarsi*, and *ossa sesamoidea*, and the *Phalanges*.

Movements: Flexion limited by the lateral ligaments and extensor tendons. Extension restrained by the inferior portion of the capsular ligament. Both these more marked than abduction and adduction which, moreover, only occur between the metatarsal bones and first phalanges. The great toe is far less moveable than the thumb.

OF THE MUSCLES.

MYOLOGIA.

"The application of muscles in an animal body is either to produce a quantity of motion equal to the quantity of contraction of the muscle; or, by the application of levers, to give a greater motion than could be produced by the single contraction of the muscle. This, in general, is not the case in machines composed by art; for in art the principal reason for the introduction of mechanics is to acquire power in the effect, which obliges us to increase the velocity in the moving cause, as in levers and pulleys."

HUNTER. *Croonian Lectures*, No. III.

MUSCLES.

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141. MUSCLES, *MUSCULI*,

form the soft fibrous organs, the substance of which is known by the name of flesh, and which, by the capacity they enjoy of contracting, produce, in an especial manner, the movement which is permitted by the articular connection of the bones and the mobility of the soft parts. They consist, independently of fibro-cellular tissue, vessels and nerves which enter into their formation, of a peculiar tissue which is closely related to that of the contractile coat of vessels.

142. a. Tissue of muscles.

Every muscle is composed of a number of bundles of fibres, each of which again consists of filaments which are even once more divisible; so that we may distinguish primary, secondary, and tertiary divisions. All are united together by a general fibrous envelope, *perimysium*, as well as each being surrounded by its own particular investment, which connects it with the sheath. The tertiary bundles are three-sided, prismatic, about 2''' broad, and consist of the flat secondary divisions, lying longitudinally to one another, $\frac{1}{4}$ to $\frac{1}{2}$ ''' broad, which on their side are formed of the red or pale, flat, fine primary divisions, 0.005''' in diameter.

In the primary bundles we observe under the microscope many, 10 to 500, longitudinal striæ, which also display many delicate filaments, fibrillæ, primitive filaments, lying parallel to one another, appearing of a yellowish red, and perforated by transverse striæ, or even only little points, whereby an angular, articulated appearance is produced. Whether a canal exists in the axis of the primary bundle, filled with a gelatinous substance, as in the Embryo, according to Valentin, is still doubtful. The longitudinal striæ, even the primitive filaments also, and transverse striæ, are not found in all muscles.

Hence we distinguish, transversely striped, striated [compound] (varicose, articulated), and unstriped [simple] organic muscular fibres.

1. To the striated belong all the so-called animal, or muscles of voluntary movement, and of the heart.

2. To the unstriped all the so-called organic, or muscles of involuntary movement, with exception of the *heart*.

143. b. Characteristics of muscular tissue.

1. Chemical. It is little changed by water and spirits of wine; very easily decomposes, and at last breaks up by means of Gastric juice into globules, but yields on boiling only very little gelatin (from the sheaths). Primitive fibres and sheaths are soluble in concentrated, are rendered transparent and soft by dilute acetic acid; by *Potass. carb.* firm, in consequence of which the wave-like and cylindrical form of the fibres shows very distinctly.

Chemical constituents: much water (0.77), Albumen, and Hæmatin, Alcoholic and watery extract, with some phosphorus, soda, and lime, and lactic acid; lastly, fibrin, fat, and gelatin.

2. Physical Characters. The red colour of the muscles is not dependent

upon the capillary vessels ramifying throughout, but upon a peculiarity in the colouring matter united with them. The fibres are soft, but firm, and during life with difficulty torn; their elasticity is trifling. After death they become stiff (from seven to ten minutes), as the fibrin coagulates, which is the rigidity of death, *rigor mortis*.

3. Physiological Characters. Muscles are endowed with the faculty of contracting in the direction of their fibres. In consequence, those parts between which they are attached approach more closely together. The contraction, by means of which the fibres shorten, become closer and harder, occurs in consequence of the sudden bending together of the fibres, from the extremities towards the centre, or curling up in a zigzag form, in the transverse striæ (*crispatio*), and is the result of an influence, which the will, the blood, and certain external irritations, exercise upon the numerous interlaced (motor) nerve fibres in the muscles. The irritability (*irritabilitas Halleri*) of the muscles (produced by galvanism, cold, &c.) is only extinct some time after death. Also, the slight shortening maintained during life (tension, *tonus*) terminates immediately with death, or by palsy of the nerves. Whilst at rest the muscles possess their greatest power (Schwann). During every continued movement a small quantity of Plasma is effused which, becoming metamorphosed into the substance of the muscle, accounts for their increase of size. Muscles act (generally) as the power in levers of the third order, that is to a disadvantage, since the power is broken between the fulcrum and the weight.

144. c. Vessels and nerves of muscles.

Arteries. They generally enter on the inner side of the middle part of the muscle, dividing between the larger bundles into large branches, from which smaller pass off between the smaller bundles, until they finally go into a long capillary network which encompasses the primitive fibres, and discharges into the veins which follow the course of the arteries.

Nerves correspond in number and size (not always) to that of the muscles. The nerves of motion principally prevail over those of sensation, in muscles, with which their trifling degree of sensation corresponds. They generally enter the muscle at the posterior part of the superior fourth, take a course like the arteries, but form loops at the ends, from which delicate filaments pass off and encompass the primary bundles of fibres.

145. d. Classification of muscles.

In each muscle we may distinguish the fleshy central portion (belly); the origin, the fixed point, head; the insertion, the moving point, tail. Both the last are provided with tendinous fibres.

1. According to the structure we distinguish animal and organic muscles. (See before.)

a. The animal muscles are striated, generally dark red, attached especially to bones, and lie on the external boundary of the body; they are connected by tendons, and have antagonist muscles; they are generally thick, cylindrical, sometimes even expanded like a membrane; lastly, they are stimulated to motion by the will. To this class belong the muscles of the trunk [and extremities] and of the commencement of internal canals.

β. The inorganic muscles are unstriated, generally pale red, lie in the inte-

rior of cavities (chest and abdomen), expanded in a manner resembling and between membranes, without tendons and antagonist muscles. They are *not* under the influence of the will. To this class belong: the muscular coats of the intestines and excretory ducts; and the fibres of the heart which, however, belong to it, only in relation to their involuntary movement.

2. According to their actions we distinguish—

a. Antagonising muscles, *antagonistæ*; for example, flexor and extensor muscles.

β. Associated, *socii*, which act simultaneously to produce a certain effect.

γ. Flexors, *flexores*, and Extensors, *extensores*.

δ. Ab- and Adductors, *ab-* and *adductores*, which remove parts from, or bring them to, the middle line of the body.

ε. Rotators, *rotatores*, which roll a part upon its axis, inwards (*pronatores*) or outwards (*supinatores*).

3. According to their shape, voluntary muscles are distinguished, as

a. Long muscles, which arise either with one, two, or several heads or dentations from a fixed point, form one or more thick central portions (belly), and are attached either with a single or divided ends (tail) to the moveable point.

β. Flat, broad muscles, are thin, tri- or quadrangular, like a membrane, lie on the parietes of cavities, and terminate with Aponeuroses; e. g., the abdominal muscles.

γ. Closing, circular muscles, *sphincteres*, with circular, encompassing primitive fibres, lying round about natural openings; e. g., Sphincter Ani.

We likewise find, among the class of involuntary muscles, layers of longitudinal and circular fibres, with others, crossing each other in various ways (hollow muscles).

146.

e. Auxiliary organs of muscles.

1. Tendons. Their fibres are not continuations of the muscular, but are only embraced by them, so that the two are separated by boiling; even the capillary vessels of the muscles do not pass into them. Sinews, *tendines*, are the cord-like tendons which form the prolongations of the muscles, and often extend to considerable length. When the muscular fibres are continued upon both sides, the so-called penniform muscles arise, when only on one side the semi-penniform.

a. Aponeuroses are flat expansions of the tendons, which occur with flat muscles, and which are generally united, as they lie on the same plane, e. g., on the skull.

b. *Fasciæ* (also called aponeuroses), tendinous envelopes for the muscles, surrounding and isolating separate muscles and groups of muscles, maintaining them in their situation, and even serving for their attachment, since they send off, in many places, processes to the bones (ligg. intermuscularia); also the sinews with peculiarly long sheaths (*vaginæ tendinium fibrosæ*); or provided with narrow restraining bands (*retinacula*), to prevent displacement.

Fascia superficialis is such an envelope, which lies close beneath the corium, and surrounds all superficial muscles. It consists of fibrous laminae crossing each other, and interwoven with elastic fibres, between which lie fat, superficial nerves and vessels.

147. 2. Fibro-cartilaginous portions, pulleys, (trochleæ), and grooves, on which the tendons in several places glide, to prevent friction, firmly attached by both extremities to the bones.

148. 3. Serous structures on the tendons, to assist their free movement over bones, cartilages, &c. There are:

a. Mucous sacs, *bursæ mucosæ*, 1. *synoviales*, generally closed sacs, which lie between the muscles and bones, and connected with both, particularly over joints, into which they frequently open; e. g., on the *m. subscapular* of the shoulder joint.

b. Mucous sheaths, *vaginæ mucosæ* s. *synoviales*, long (closed) sacs, through which a canal passes for a free tendon, with which it is connected; e. g., *Biceps brachii*.

I. Muscles on the Head.

A. Muscles of the Cranium, *Occipito-frontalis* s. *Epicranius*.

149. 1. *Occipitalis*, Occipital muscle.

Shape: obliquely four-sided, weak. Position: close beneath the skin of the occipital region. Origin from *linea semicircular. superior*, extending from close to the middle line to the base of *proc. mastoid*. Insertion: *Galea aponeurotica*. Action: draws the skin of the head backwards, rendering the forehead smooth.

Nerves: *supraorbital*, *supra* and *infra trochlear.*, *rr. temporal. n. facialis*.

150. 2. *Frontalis*, Frontal muscle.

Shape: obliquely four-sided, above arched, flat. Position: close beneath the skin of the forehead, from the root of the nose to the frontal eminence. Before the *Glabella* the internal borders of both meet together. Origin: root of nose and *arcus superciliaris*. Insertion: *Galea aponeurotica*. Action: elevates the skin of the forehead and eyebrows (making transverse wrinkles), stretches the skin of the back of the nose (by means of the so-called *procerus nasi*).

Nerves: *occipital major.* and *min. auricular. post.*

Galea aponeurotica, that is, the tendinous cap which lies between the two occipital and frontal muscles, formed of their tendons, attached besides to the root of the *proc. mastoid.* to the zygomatic arch as far as the external angle of the eye, intimately united with the skin of the head (less with the periosteum), covered with fat (in which are many nerves and vessels). Behind it is thick and brilliantly white, on the sides thinner.

B. Muscles of the external Ears.

151. 1. *Attollens auriculæ*, elevator of the ear.

Shape: triangular, thin. Position: close beneath the skin of the temporal fossa above the ear. Origin: *Galea aponeurotica*. Insertion: broad, on the posterior surface (between the divisions) of the *anthelix*. Action: raises the auricle.

152. 2. *Protrahens s. auricularis anterior*.

Figure: small, thin. Position: above the zygoma, beneath the skin; covers *art.* and *ven. temporalis* and *fascia temporal*. Origin: *Galea aponeurotica*. Insertion: in front of the *helix*. Action: draws the auricle forwards and upwards.

Nerves: *temporal. superfic. (auricular. anter.) subcutan., tempor. facia.*

153. 3. *Retrahentes*, 2 retractors of the auricle.

Figure: roundish, flat, small. Position: above the origin of the *Sterno-mastoid* muscle. Origin: *proc. mastoideus*. Insertion: the external convex surface of the auricle. Action: they draw the upper portion of the auricle backwards.

Nerves: *auricular. post. vagi, occipital. minor.*

154. 4. Muscles which may serve for the movement of individual parts, but however are only perceptible as exceptions. *Helicis major* and *minor*, *Tragicus*, *Antitragicus*, *Transversus auriculæ*, *Dilator conchæ* (see Ear). Hyrtl describes a *m. stylo-auricularis*, which passes from *proc. styloideus* to the inferior surface of the cartilaginous *meatus auditorius*, but generally represented by a tendinous cord.

C. Muscles of the Eyelids.

155. 1. *Orbicularis s. sphincter palpebrarum*.

Figure: flat, rather thin, consisting of an external and an internal layer. From the internal angle of the eyes a four-sided fasciculus passes, *m. Horneri s. Tensor tarsi s. sacci lacrymalis*, which goes behind the tarsal ligament around the lacrymal canal to the crista of the lacrymal bone. Position: beneath the skin of the lids and borders of the orbits. The internal layer arched from *lig. palpebrar. intern.* to *externum.*, and from the borders of the orbits to the tarsal cartilages, covers the roots of the cilia. The

external (red) layer upon the borders of the orbits covers *corrugator supercil.* parts of *frontalis*, *temporal.*, *zygomaticus* and *levator labii alæq. nasi*. Origin: the internal angle of the eyes, *lig. palpebrale internum*. Insertion: the same, only rather farther towards the nose. The internal layers of the superior and the inferior eyelids are separated from one another. Action: the internal layer closes the eye and presses the bulb a little backwards. The external shortens at the same time the fissure between the lids, and corrugates the skin at the internal angle. Horner's muscles merely draw the puncta lacrymalia deeper inwards; they may also compress the lacrymal sacs.

Nerves: *palpebrales* from *supra-, infra-orbital.*: and *trochlear.*, *lacrymal.*, *subcutan. mal.*, *rr. temporal. n. facialis*.

156.

2. *Corrugator supercilii.*

Figure: arched, narrow, flat. Position: upon the *arcus superciliaris*, covered by *frontalis* and *sphinct. palpebr.* Origin: the root of the nose. Insertion: to the superciliary arch as far as the temple. Action: draws the brow inwards and downwards, thereby corrugating the skin over the root of the nose lengthwise.

Nerves: as *frontalis*.

157.

3. *Levator palpebræ superioris.*

Figure: long, flat, and narrow. Position: between the roof of the orbits and the *rectus bulbi sup.*; above it, passes *n. frontalis (trigem.)*. Origin: close above the *optic foramen* from *ala parva* of the sphenoid bone and sheath of *nerv. opticus*. Insertion: with a broad aponeurosis to the superior border of the tarsus. Action: draws back the superior lid upwards, particularly on elevation of the globe.

Nerves: *oculo-motorius*.

D. Muscles of the Nose.

158.

1. *Depressor alæ nasi.*

Position: close upon the upper jaw, covered by *sphinct. oris* and *levat. labii alæq. nasi*. Origin: before the roots of the two *incisor* and the *canine* teeth. Insertion: the posterior part of the *septum mobile* and the *alæ nasi*. Action: draws the inferior part of the nose downwards and backwards (*sulcus naso-labialis* becomes deeper.) Fibres from it penetrate the upper lip; these are *m. Incisivus (Cowperi) superior*.

159. 2. *Compressor narium s. transversus nasi.*

Figure: below, narrow (fleshy), above, broad, three-sided (tendinous). Position: arched upon the cartilaginous part of the nose, where both meet together. Origin: between the roots of the *canine* and *first molar teeth*, in the *sulcus naso-labialis*. Insertion: the back of the nose below the bony portion. Action: rather to compress the nose, drawing the skin downwards, and widening the nasal openings.

Nerves: *infraorbital*. and *ethmoidalis*.

160. 3. *Dilatator narium posterior.*

Fig.: small. Pos.: at the posterior part of the *alæ nasi*, covered by *depressor* and *compressor*. Or.: the border of the *proc. ascend.* of the upper jaw. Ins.: below to the skin of the posterior half of the nasal openings. Act.: widens behind the nasal openings.

161. 4. *Dilatator narium anterior.*

Pos.: on the *alæ* close to the back of the nose. Or.: the superior border of the alar cartilages of the nose. Ins.: the skin of the anterior part of the border of the nasal openings. Act.: draws the anterior portion of the *alæ nasi* outwards.

Nerves: *infraorbital* and *facialis*.

Remarks. The rest of the nasal muscles are not independent, but continuations of neighboring muscles; viz.

a. *Procerus* (s. *pyramidalis*) a continuation of *frontalis*, upon the dorsum of the nose. Act.: draws the skin of the back of the nose upwards, stretching it.

b. *Depressor septi mobilis* a portion of *sphincter oris*, in the fossa of the upper lip. Act.: draws the point of the nose upwards; contracting the nasal openings.

c. *Pyramidalis* s. *Levator labii superioris alæque nasi*.

E. Muscles of the Lips, the Cheeks, and the Chin.

162. 1. *Orbicularis* s. *sphincter oris*, the muscle closing the mouth.

Pos.: round about the oral fissure in the lips, between the mucous membrane and the external skin; connected on the external circumference with the rest of the labial muscles (whose continuation it forms). Or. and Ins.: *septum mobile nasi*. Act.: closes, points, and presses the lips against the teeth (*m. osculatorius*).

Nerves: *infraorbit.*, *mental.*, *buccinat.*, *facial*.

163. 2. *Buccinator*, cheek muscles.

Fig.: oblong, broad, flat. Pos.: between upper and lower jaw; behind covered by the ramus of the lower jaw, *masseter* and *temporalis*; before by *zygomatici*, *risorius*; perforated by *duct. Stenonian*. (opposite the three superior molar teeth); covered internally by the buccal mucous membrane. Or.: 1. Over the last molar tooth. 2. *Hamulus* of *proc. pterygoid*. 3. *Alveolus* of the upper and lower jaws. Ins.: *sphincter oris*. Act.: draws the angles of the mouth outwards; contracts the buccal cavity (in whistling, blowing).

Nerves: *buccinator*, *buccales*, *facialis*.

164. 3. *Levator labii superioris alæque nasi*,
(*Pyramidalis* of Theile.)

Fig.: flat, divided below. Pos.: on the side of the nose, somewhat covered above, by *sphincter palpebr.*, then, below, by the skin, above, compressor and depressor alæ nasi. Or.: *proc. frontal.* of upper jaw to *lig. palpebr. intern.* Ins.: the stronger portion to *sphincter oris*, the weaker to the *ala nasi*. Act.: elevates the *ala nasi*, corrugates the nasal membrane, and raises the upper lip at the same time.

165. 4. *Levator labii superioris proprius* s. *Incisorius*.

Fig.: flat, four-sided, broader above. Pos.: covered above by *sphinct. palpebr.*, then only by the skin on the external border of this muscle, on the inner of the *zygomatic minor*, with which it is united below. Or.: above *foram. infraorbitale*. Ins.: *sphincter oris* and skin of upper lip. Act.: elevates the upper lip.

166. 5. *Levator anguli oris* (s. *Caninus*).

Pos.: vertical; external to the one last described; covered by it, below free. Or.: half an inch below *foram. infraorb.*, broad. Ins.: *sphincter oris*, *depressor labii inferior*. Act.: raises the angle of the mouth somewhat inwards.

167. 6. *Zygomaticus minor*, small zygomatic muscle,
sometimes wanting.

Pos.: oblique, at commencement covered by *orbic. palpebr.*, upon the last described, free beneath the skin. Or.: *os zygomatic*. Ins.: the upper lip; mingling with *levator labii prop.* Act.: raises the upper lip and draws it somewhat outwards.

168. 7. *Zygomaticus major*, greater zygomatic muscle.

Pos.: oblique; external and below the last described; covered below by the fat of the cheek, above by *orbicular palpebr.* Or.: *os zygomatic.* Ins.: the angle of the mouth. Act.: draws the angle of the mouth outwards and upwards.

169. 8. *Depressor anguli oris* (s. *triangularis menti*).

Pos.: beneath the skin at the sides of the chin; covers the *quadrat. menti* internally, the *buccinator* externally. Or.: broad, from *basis maxill. infer.* Ins.: pointed, to the angle of the mouth (*levator anguli* and *zygomatic. major*). Act.: draws the angle of the mouth outwards and downwards (physiognomy of the simple).

170. 9. *Risorius* (*Santorini*), laughter muscle, thin, three-sided.

in the fat of the cheeks, upon *m. platysmam.* Or.: *fascia masseter.* Ins.: *m. zygomatic. major.* Act.: draws the inferior internal part of the cheeks outwards and upwards, so that (in laughing) a small fossa is formed in the skin.

171. 10. *Depressor labii inferioris* (s. *quadratus menti*).

Pos.: close beneath the skin of the chin, covers the *sphincter oris* and *lev. menti.* Or.: the inferior border of the chin. Ins.: the under lip. Act.: draws the under lip downwards, both together stretch it.

172.

11. *Levator menti.*

Pos.: in the chin, bounded above by the sphincter oris, covered externally by *quadratus*; in the centre the fibres of both sides pass over, above, in an arched manner, into one another; below, they are united by firm fibro-cellular tissue, and free. Or.: below the corner tooth of the lower jaw. Ins.: skin and fat of the chin. Act.: draws the skin of the chin upwards, corrugates it, and pushes up the lower lip. Its most superior fibres (*m. incisivus inferior*) penetrate the under lip, and are said to compress it against the gums.

173. 12. *Transversalis menti*,—wanting in feeble subjects.

Pos.: transverse below the free border of the chin, upon *m. platysmam.* Or.: continuation of *triangularis menti.* Ins.: the internal angle of both *mm. triangulares.* Act.: stretches the skin on the chin.

Nerves: (for three to twelve) *facialis*; for the superior muscles; *infra orbital.* and *subcutan.*, for the inferior; *mentalis.*

F. Muscles of the Lower Jaw,—of mastication,
mansores s. manducatores.

174. 1. *Masseter*, masticating muscle; external and internal portion.

Pos.: before and upon the *ramus maxill. infer.*, between *arcus zygomat.* and *angulus maxill.*; above, covered by *zygomatic major*; behind, by the Parotis. Close to its anterior border below: *art. maxillar. extern.* Or.: the inferior border of the zygoma. Ins.: angle and external surface of *ram. maxill. infer.* Act.: draws the lower jaw (very strongly) upwards.

175. 2. *Temporalis* (s. *crotaphites*), temporal muscle.

Pos.: fills up the temporal fossa; covers *m. pterygoid. extern.*, *buccinator* (somewhat), *art. maxillar. intern.* and *vasa temporall. proff.* Or.: *linea semicircularis* and the walls of the temporal fossa. Ins.: *process. coronoid.* of the lower jaw. Act.: draws the lower jaw upwards, and the *condyl. maxill.* backwards into the articular fossa.

176. 3. *Pterygoideus internus* (s. *major*) thick, four-sided, (*masseter internus*).

Pos.: in the *fossa zygomat.*, along the inner surface of the *ramus maxill. infer.*, separated from it by *nn. dental.*, *lingual.*, *art.* and *ven. dental. infer.*, and *lig. laterale intern.* External to *m. circumflex. palati*, *gland. submaxillar.* and *pharynx*. Or.: *fossa pterygoidea*. Ins.: *angulus maxillæ* (internal surfaces). Act.: draws the lower jaw strongly upwards, as well as rather inwards.

177. 4. *Pterygoideus externus* (s. *minor*), short and thick.

Pos.: horizontal between *ala externa proc. pteryg.* and *collum maxill. infer.*;—on the outer side of *pterygoid. intern.*, inside of *ram. maxill.* and *m. temporalis*. Or.: by two heads (which frequently embrace *art. maxill. intern.*); a. from the external surface of *ala extern. proc. pterygoid.* and *proc. pyramid. oss. palati*. b. from the *crista* and *spina alæ magnæ* of the *sphenoid* bone, between *fossa temporal.* and *zygomatica*. Ins.: the depression before the *collum condyli maxill.*, and the circumference of the interarticular cartilage. Act.: draws the lower jaw forwards and pushes it to the other side; both acting together draw it directly forwards.

Nerves: (for one to four) *ramus 3 trigemini*.

Fasciæ of the Head.

178. 1. *Galea capitis*. See before.

179. 2. *F. temporalis*, is covered at the upper part by the *Galea*, but is not even connected, where free, with the external skin. It covers the temporal muscle, dividing inferiorly into a superficial delicate layer which is attached to the superior border, and a deep one, to the internal surface of the zygomatic arch; between the two there is fat and a branch of the *art. temporalis*; between it and the temporal muscle likewise much fat. It is very dense. (Pus does not readily penetrate it, but it gravitates towards the malar-maxillary fossa.)

180. 3. *F. buccalis*: a. Superficial layer, that is, *F. parotidæa*, very dense, especially on the external surface of the Parotis, covering it like a sheath (pus does not penetrate it and the skin easily); continuing as *F. masseterica*, where behind it appears to divide, covering the *m. masseter* and *ductus Stenonianus*, above and in front losing itself in fibro-cellular tissue. (Pus behind it sinks towards the neck, that before it comes to the skin.)

181. b. Deep layer, *F. bucco-pharyngea*, covers *m. buccinator*, serving anteriorly for the attachment of this, posteriorly much thicker, for that of the *m. constrictor pharyngis super.*, since it passes away behind *m. pterygoid. intern.*, and, like a, is connected with the *F. cervicalis*. It separates the muscles from the buccal mucous membrane. (Pus does not easily find its way through these fasciæ towards the mouth and the reverse.)

II. Muscles of the Neck.

A. Superficial cervical muscles.

182. 1. *Platysma-myoides* (s. *latissimus* s. *subcutaneous colli*).

Pos.: broad, close behind the skin, below firmly, above, united with it by fat, on the sides of the neck, before the *fasc. cervicalis*. The two diverge from above downwards. Or.: the anterior superior part of the chest (two to three ribs) before *m. pectoralis major*. Ins.: *Basis maxill. infer.*, angle of mouth, *Masseter*, skin of the face. Act.: draws the skin of the neck, somewhat the lower jaw and under lip, downwards.

Nerves: *subcutanei, colli supraclaviculares*.

183. 2. *Sterno-cleido-mastoideus*.

Pos.: above at the sides, below on the anterior surface of the neck; covered by the skin, by *m. platysma myoid.*, separated

from the last by *Vena jugular. extern.* and *Plex. nerv. cervical. superfic.* Behind it, 1. *Mm. sterno-hyoideus, thyreoid., omo-hyoid., splenius, digastricus, scaleni.* 2. *Nn. vagus* and *accessor., sympathicus, hypoglossus, cervicales.* 3. *Carotis communis, Vena jugular. intern.* On the anterior border above, *Parotis.* The two diverge from below upwards. The posterior border forms with the *Clavicula* an acute angle, with these and the *M. trapezius* a triangle. Or.: two portions. 1. *Cleido-mast.* from the internal extremity of the *Clavicula.* 2. *Sterno-mast.* from *manubrium sterni.* Ins.: external surface of *Proc. mastoid. oss. temporis* and *linea semicircular. superior oss. occipitis.* Act.: both together draw the head directly forwards and downwards, bowing it; one alone acting draws it in such a direction that the face looks towards the opposite side.

Nerves: *accessor. Willis., plexus cervical.*

a. Below the Os Hyoides.

184. 3. *Sterno-hyoideus* (often double).

Pos.: vertical in the centre of the neck; covered by *M. platysmam., sterno-cleidom.* and *fascia cervicalis*, before the deep cervical muscles and *Art. thyreoidea superior.* The inner borders meet together. Fig.: flat, riband-like, thin. Or.: the posterior surfaces of the Sternal ends of the *Clavicula* (frequently the *Manubrium sterni*). Ins.: the inferior border of the body of *os hyoides*, close to the middle line, to the inside of *M. brachyoides.* Act.: draws the *os hyoid.* downwards.

185. 4. *Omo-hyoideus* (sometimes wanting).

Pos.: oblique on the side of the neck, commencing parallel with the *Clavicula*, then forming an obtuse angle upwards and inwards; covered by *trapezius, subclavius, platysmam., sterno-cleido-mast.*; it crosses *Mm. scaleni*, the *Plex. brach., Ven. jugular. intern., Carotis comm.,* near *m. sterno-hyoideus.* Or.: Scapula (the superior border) behind the Incisura scapulæ. Ins.: external and close to the before-described muscle. Fig.: two-bellied, in the centre tendinous, angular. Act.: the superior belly draws the hyoid bone downwards. The posterior belly is said to stretch the *fasc. cervic.* which attaches it to the clavicle.

[*Coraco-cervicalis* (Krause), a small m. before *m. omo-hyoideus*, arises from *Proc. coracoid.,* and is attached to the *fascia cervicalis*, which it stretches.]

186.

5. *Sterno-thyreoides*.

Pos.: behind *sterno-hyoid*, diverging from below upwards, before the thyroid gland. On the outer border: *V. jugular intern.*; behind that *Carot. comm.*; on the inner border: *V. thyreoid media*. Or.: broad from *Manubrium sterni* (posterior surface) and first rib cartilage. Ins.: *Linea obliqua* of *thyroid cartilage*. Act.: draws the larynx downwards, shortening the trachea.

Nerves: (three to five) *hypoglossi ram. descendens*.

187.

6. *Thyro-hyoideus*.

Pos.: behind the *m. sterno-hyoideus*, vertical before the *memb. thyreoides*. Or.: *os hyoides* (the inferior border of the body and root of great cornua). Ins.: *Thyroid cartilage (linea obliqua)*. Act.: approximates *hyoid bone* and *larynx*; assists in throwing the *epiglottis* backwards.

[*Thyreoides* is a prolongation of the thyroid gland upwards; it contains no muscular fibres.]

Nerves: *laryngeus superior* and *hypoglossus*.

b. Above the Os Hyoides.

188. 7. *Digastricus* (s. *biventer maxillæ inferioris*).

Pos.: in the semicircle between the temporal, hyoid bone and centre of lower jaw, below the angle of the last; covered by *M. platysma myoides*; behind by the *Parotis* and *Gland. submaxill.* Internally to it lie *Carotis interna* and *N. hypogloss.*; the posterior belly perforates on the hyoid bone, the *M. stylo-hyoideus*. Or.: 1. Post. belly: from *Incisura mastoidea*, covered by *M. sterno-cleido-mastoid*. 2. Anterior belly: from *os hyoides*. Ins.: 1. *Os hyoides*. 2. Lower jaw (*base*). Act.: the anterior belly elevates the hyoid bone towards the lower jaw, the post. draws it backwards and upwards.

Nerves: post. belly, *facialis*; [ant. belly, *trigeninus*.]

189.

8. *Stylo-hyoideus*.

Pos.: between temporal and hyoid bones, covered externally by the posterior belly of the digastric muscle by which it is perforated shortly before its point of insertion. Or.: *Proc. styloideus* (the centre of the external surface). Ins.: the *Os hyoides*, at the union of its great cornu with the body. Use: to draw the hyoid

bone obliquely backwards and upwards; elevates the root of the tongue, and contracts the *isthm. faucium*.

Nerves: *facialis*.

190. 9. *Mylo-hyoideus* (s. *transversus mandibulæ*).

Pos.: extended like a partition from the lower jaw to the hyoid bone; above *M. digastric.* (ant. belly) and *Gland. submaxillar.*; beneath *Mm. genio-hyoid., hyo-, stylo-glossus, Nn. lingualis* and *hypo-glossus, Gland. subling.* and *oral mucous memb.* Or.: broad from the entire *Lin. obliq. interna* of the lower jaw. Ins.: pointed to the centre of the body of the hyoid bone. [Meets its fellow in the middle line of the body.] Use: draws the hyoid bone upwards, or the lower jaw downwards.

Nerves: *trigeminus*.

191. 10. *Genio-hyoideus*.

Pos.: above the last *m.*, beneath *m. genio-glossus*, between chin and hyoid bone, below and behind. Or.: the chin (*spina mentalis interna*). Ins.: Hyoid bone (the superior anterior part of the centre). Use: draws the hyoid bone forwards and upwards, or the lower jaw downwards.

Nerves: *hypoglossus*.

B. Muscles of the Tongue, of the Pharynx, and Palate.

192. 1. *Linguales*, Tongue muscle.

a. *Longitudinalis superior*, anteriorly beneath the thick membrane of the tongue, behind beneath the glandular layer, along the entire dorsum of the tongue. Use: to shorten the tongue, curving the apex upwards and backwards.

b. *Longitudinalis inferior* (especially the *lingualis*), spindle-shaped on the under surface close to the middle line, between genio- and hyo-glossi. Use: to shorten the tongue, curving the point downwards.

2. *Transversus*, springs from the fibrous septum in the centre of the tongue; its fibres cross each other; lies between the two *longitudinales*. Use: to narrow, elongate, and point the tongue.

193. 2. *Stylo-glossus*.

Pos.: obliquely inwards, downwards, and forwards, partly on the borders, partly transverse in the tongue. Externally lie: *M. stylo-hyoideus, Parotis, M. pterygoid. intern., Gland. sublingual, N. lingualis*, mucous membrane of the tongue. Internally: *Lig. stylo-hyoid., Tonsilla, M. constrictor pharyng. super., hyo-*

glossus. Or.: *Proc. styloideus* (apex). Ins.: double in *M. lingualis*. Use: to draw the tongue upwards and to its own side. Both acting together draw it upwards and backwards, making it appear broad.

Nerves: *hypoglossus*.

194. 2. *Hyo-glossus* (*Basio-, Kerato-, Chondro-glossus*).

Pos.: vertical, above *M. mylo-hyoideus*. Externally: *M. stylo-gloss.*, *digastricus*, *Gland. subling.*, *Nn. hypogloss.* and *lingualis*. Internally: *Art. lingual.*, *M. geniogloss*, *constrict. med.* Or.: three-fold from the hyoid bone; 1. from body; 2. from greater; 3. from lesser cornu. Ins.: root of tongue (*m. lingualis*). Use: to draw the tongue downwards and backwards; both acting, draw it down and narrow it.

195. 4. *Genio-glossus* [*Genio-hyo-glossus*].

Pos.: close above *M. genio-hyoideus*, horizontal, beneath the oral mucous membrane and the tongue. On the inside both meet together. Outside: *Gland. subling.*, *N. hypogl.*, and the muscles before mentioned. Fig.: thick, three-sided, large. Or.: chin (*spina interna*). Ins.: tongue. The posterior fibres pass to the hyoid bone, the anterior curved from the root to the apex of the tongue to the *m. lingualis*. Use: both extend the tongue forwards, draw it again backwards, and press it together to form a furrow.

Nerves: (three to four) *lingual*, *trigemini*, *glosso-pharyng.* and *hypoglossus*.

196. 5. *Constrictores pharyngis*, three constrictors of the pharynx,

form the posterior, muscular parietes of the pharynx, in the centre of which they meet together in a white line [raphe] formed of fibro-cellular tissue. From behind we first see:

a. *Constrictor pharyngis inferior*, the strongest of the three muscles, extending the lowest downwards. Its fibres pass from the raphe downwards, outwards, and forwards, blending immediately with those of the œsophagus (see *Splanchnol.*), and reaching above to the *constrictor superior*. Inferior attachments: 1. *Cartilago cricoidea* (thence, *crico-pharyngeus*). 2. *C. thyreoidea* (*M. thyreo-pharyngeus*). 3. *Lig. hyo-thyreoideum laterale* (*M. syndesmo-pharyngeus*). Superior attachments: raphe.

b. *Constrictor pharyngis medius*.—Inf. attach.: 1. *Cornu maj. oss. hyoidei* (thence, *M. cerato-pharyngeus*). 2. *Cornu minus oss. hyoidei* (thence, *M. chondro-pharyngeus*). Superior attach.: 1. raphe. 2. *Oss. occipitis pars basilaris*.

c. *Constrictor pharyngis superior*. Inf. attach.: 1. Mucous membrane of pharynx. 2. *M. stylo-pharyngeus* with horizontal fibres; terminating on the thyroid cartilage covered by *Constr. inf.* Superior attach.: 1. *Proc. pterygoideus-hamulus* and *ala interna* (therefore, *pterygo-pharyngeus*). 2. *M. buccinator* (*bucco-pharyngeus*). 3. *Linea obliq. maxill. inf.* (therefore, *mylo-pharyngeus*). 4. *M. genio glossus* (therefore, *genio- and glosso-pharyngeus*). Use: to press the posterior walls of the pharynx together and to contract it.

Nerves: *glosso-pharyngeus* and *vagus*.

197. 6. *Stylo-pharyngeus* (s. *levator pharyngis*).

Pos.: oblique from above, downwards and inwards, between *m. stylo-hyoid* and *digastricus* (behind) and *m. stylo-glossus* (before). Externally lie, *m. stylogloss.*, *carotis externa* and *parotis*; internally, *carotis intern.* and *V. jugular. int.*; along the outer side, *n. glosso-pharyngeus*. Or.: round, from *Proc. styloideus* (inner surface). Ins.: between the fibres of *mm. constrictor sup.* and *med.*, the last of which covers it. Use: to raise and widen the pharynx above the hyoid bone.

Nerves: *glosso-pharyngeus*.

198. 7. *Levator palati mollis* (s. *peristaphylinus internus* s. *petro-salpingo-staphylinus*).

Pos.: obliquely inwards, forwards, and downwards on the *ala interna* of *Proc. pterygoideus*. Or.: the petrous bone (apex) and cartilaginous portion of *tuba Eustachii*. Ins.: between the layers of the soft palate, behind *m. pharyngo-palatinus*. Use: to draw the *velum pendulum palati* upwards towards the posterior nasal openings, by which these are contracted, and the passage of the fauces widened.

199. 8. *Circumflexus* s. *tensor palati mollis* (s. *peristaphylinus externus*, *spheno-salpingo-staphylinus*).

Pos.: close to the outer side of the last, separated by the *ala interna Proc. pteryg.*; the tendon passes away below the *Hamul. Proc. pterygoid.* inwards, at a right angle. Or.: *Proc. spinosus* of *sphenoid* bone, *tuba Eustachii* (cartilage). Ins.: before the last, with a thinner aponeurosis. Use: both draw the *velum-palati* in a transverse direction, outwards. Whether it serves this purpose, or for widening the posterior nasal openings and the *tuba Eustachii*, is doubtful.

200. 9. *Azygos uvulæ* (s. *palato-staphylinus* [s. *levatores uvulæ*].)

Pos.: vertical in the uvula, below the last. Or.: *spina*

nasalis posterior. Ins.: mucous membrane of uvula. Use: to raise, shorten, and also curve the uvula.

201. 10. *Glosso-palatinus* (s. *constrictor isthmi faucium*.)

Pos.: in the anterior palatine arch [or pillar of the fauces], between the palate and tongue, small and narrow. Or.: the sides of the root of the tongue (*m. styloglossus*). Ins.: the soft palate (blending with *m. pharyngo-palatin*). Use: to approximate the palate and tongue, and thereby contract the fauces.

202. 11. *Pharyngo-palatinus* (s. *constrictor isthmi faucium superior*).

Pos.: in the posterior palatine arch, below, *m. levator palati* (above); internal to the other palatine muscles, covered by the mucous membrane. Or.: from the posterior border of the thyroid cartilage ascending behind the tonsil glands. Ins.: the soft palate (*m. levator* and *circumflexus palati*). Use: to draw the soft palate down, or the posterior wall of the pharynx upwards (as in swallowing).

C. Deep Cervical Muscles.

a. Anterior.

203. 1. *Longus colli*.

Pos.: on the anterior lateral surfaces of the vertebra, behind: *Pharynx*, *Œsophagus*, *Art. carotis* and *Ven. jugular intern.*, *nn. vagus* and *sympathicus*. Or.: from the ninth to the sixth vertebral body and transverse processes with an *inferior* and *superior* portion.

Ins.: the anterior surface of the fifth to the first vertebral body (*tuberculum atlantis anticum*). Use: to flex the neck (and head), if both act; one alone acting draws it in such a direction that the face looks to the opposite side.

204. 2. *Rectus capitis anticus major*.

Pos.: close, external to and above the last muscle, before *m. rect. capt. ant. minor*. Or.: from the front of the *Proc. transvers. vertebr.* from the third to the sixth. Ins.: close in front of *for. magn. occipit.* Use: to flex and rotate the head somewhat sideways.

205. 3. *Rectus capitis anticus minor*.

Pos.: oblique, behind and next to the last muscle, behind the Ganglion I. cervic. n. sympathici; in front of the articulation of the atlas with the occipital bone. Or.: *Atlas (radix. anter. proc.*

transversi). Ins.: *Pars basilaris occipitis*. Use: to bend the head somewhat to the side and forwards.

b. Lateral.

206.

4. *Rectus capitis lateralis*.

Pos.: vertical (behind, *V. jugularis*, before, *Art. vertebral.*); behind the pharynx, before *obliq. capit super.*, to the inside of *biventer maxillæ*. Or.: *Proc. transvers. Atlantis*, outside the last muscle. Ins.: *os occipitis*; between *foram. jugulare* and *stylo-mastoid*. Use: bends the head to the side.

207.

5. *Scalenus anticus*.

Pos.: below and behind *Musc.* and *Ven. subclavia*, above and behind *m. sterno-mastoid*, *Omo-hyoid.*, *n. phrenicus*, *art. cerv. trans.* and *ascend.*; before, a triangular space, at the base of which, below, *Art. subclavia*; in the apex: *Plexus brachialis*. Internally, *Art. vertebr.* and *m. longus colli*; externally, *scalen. med.*; rests upon the apex of the pleura. Or.: *Proc. trans. vertebr.* 3 to 6. Ins.: *Costa I.* (superior border) even to the centre. Fig.: conical, the apex above. Act.: bends the neck forwards; or raises the first rib.

208. 6. *Scalenus medius* (the strongest of the three supporters of the ribs).

Pos.: behind the last muscle, *Art. subclavia* and *Plex. brachialis*; upon it lie: *omo-hyoid*, and above, the *m. Sterno-cleido-mast.* Or.: *Proc. transv. Vv.* 1 to 7 (the anterior tubercles). Ins.: *Costa I.* (superior border, outside the last muscle), and *Costa II.* Use: to raise the first and second rib; to incline the neck laterally; both fix the neck.

209.

7. *Scalenus posticus*.

Pos.: behind and outside the last muscle, before, *cervical. descendens*. Or.: *Proc. transv. Vv.* 5 to 7. Ins.: *Costa II.* (behind the centre). Use: bends the neck sideways, or raises the second rib.

Nerves: (1—7) *rr. anteriorr. n. cervicall.*

210.

Fascia cervicalis.

Arises from the anterior belly of *digastric*, as far as the chin, from the *os. hyoides*, from the lower jaw, below *gland. submaxillar.*, to the angle between it and *Parotis*; from *proc. styloid.* and its muscles. Insertion: the superior border of the chest. Position: covered by *platysmam.* and *jugularis extern.*; upon the

muscles of the hyoid bone and larynx, between, upon, behind and external to the *Sterno-cleido-mastoidei*. We distinguish:

a. Superficial layer, fixed to the *lig. interclavicul., manubr. sterni*.

b. Deep layer, passing away behind the *sterno-cleido-mast.*; it forms a sheath for *jugular. interna* and *carotis commun.*, enveloping and attaching the omo-hyoid to the superior border of the first rib; and uniting itself with the fibro-cellular tissue upon the *scaleni* and *levator scapulæ*, which is:

211. c. *Fasciæ prævertebralis*, which surrounds the *longus colli* and *rect. capitis. antic. major*, contains below much fat and fills up the *fossa supraclavicularis*. It attaches itself to the superior part of the clavicle as far forward as the *acromion*, and forms a boundary between the *fossa superclavicul.* and the cavity of the axilla; behind, it embraces the *cucullares* [*Trapezius m.*]. Anteriorly it is covered by *Trachea*, *pharynx*, and *œsophagus*.

III. Muscles of the Chest, *Regio thoracica*.

212. 1. *Pectoralis major*, great pectoral muscle.

Pos.: beneath the skin and mammæ, on the anterior surface of the thorax and before the axilla; covering the *subclavius* and *pect. minor*. Or.: 1. *Clavicula* (one-third to one-half of the anterior border). 2. *Sternum*. 3. *Cartilagine Costar.*, 2 to 7. Ins.: *Humerus* (*spina tubercul. major*); between *biceps* (cap. breve) and *triceps*, with a tendon two inches broad, under that of the *Deltoideus*. Use: to draw the arms inwards, so that they may be crossed over the chest; fixing the humeri, to draw the ribs outwards and expand the thoracic cavity (as in inspiration).

213. 2. *Pectoralis minor* (s. *serratus anticus minor*).

Pos.: behind the last muscle, and the *Nervi* and *Vasa thorac.*; its superior border separated from the *Clavicula* by a triangular space, behind which, *Art. axillaris*, separated from *Pectoral. major* and *serratus* by fat. Or.: *Costa III.* to *V.* (superior border and external surface). Ins.: *Proc. coracoideus* (internal border and apex). Use: to draw the shoulder forwards, inwards and downwards; if this is fixed, to elevate the third to the fifth ribs (m. inspirator).

Nerves: (1—2) *thoracici, intercostal., supraclavicular.*

214. 3. *Subclavius* (*costa-clavicularis*).

Pos.: along the inferior surface and behind the *Clavicula*, above the *Vasa axillaria*, *Plex. brachial.* and first rib. Or.:

first rib. cartilage. Ins.: *Clavicula* (the external end of the inferior surface). Use: to draw the acromial end of the clavicle downwards, and press the sternal end against the sternum, on which account in fracture of the clavicle the outer end projects over the inner. Elevates also the first rib (*m. inspiratorius*), the *Clavicula* being fixed.

Nerves: *pectoral. anterr.*

215. 4. *Serratus anticus major (costo-scapularis)*.

Pos.: on the side of the thorax, covered, above, by *pectorales*, below, by *latissim. dorsi* and the skin, behind, by *subscapularis*. Or.: *Costæ* 1 to 8, external surface (with nine or ten dentations). Ins.: *Basis scapulæ* (inner lip), above and below very thick; united with *rhomboidei* and *subscapular.* by strong fibro-cellular tissue. Use: to draw the scapula forwards and outwards; or the first to the eighth ribs upwards and inwards.

Nerves: *thoracici, intercostales.*

216. 5. *Intercostales externi* and *interni*.

Pos.: in the intercostal spaces. The fibres of the external pass *forwards* and downwards, those of the internal *backwards* and downwards. Or.: the inferior border of each rib. Ins.: the superior border of the following inferior rib. *Mm. externi* reach from the neck of the rib to the cartilage. *Mm. interni* commence at the angle, terminate at the sternum. Use: both the same. They approximate the ribs, either upwards in fixing the first rib (by means of *Mm. scaleni*) *inspiratio*; or downwards in fixing the twelfth rib (by *m. quadratus lumb.*), *expiratio*.

Nerves: *intercostales.*

217. 6. *Infracostales*,

variable in number and direction, lying on the internal wall of the chest between ribs and diaphragm, vertical or oblique in shorter or longer *striæ*; and serving to assist the *Mm. intercostales*.

218. 7. *Triangularis sterni*.

Pos.: behind the sternum, before the diaphragm; separated from the rib cartilages by *Vasa mammaria*. Or.: *Corp. sterni* (the external border) and *Proc. ensiform.* Ins.: *Costæ*, two to five, together with the cartilages (the inferior border). Use: to draw the second to the fifth ribs downwards.

Nerves: *intercostales.*

219.

Fasciæ pectorales.

1. The intercostal muscles, a fascia cover externally, which is behind the continuations of the *Mm. externi*, before those of the *interni*; in the thorax they are separated by a serous layer from the diaphragm.

2. *F. coraco-clavicularis* (see *f. Humeri*) invests *m. subclavius* and *pectoralis minor*.

3. *F. superficialis*—the *m. pectoralis major*, and the inferior part of *serratus antic. major*.

220.

IV. Muscles of the Neck and Back.

We may distinguish from the skin of the back, forwards, five layers of muscles.

A. First layer.

Two muscles.—Origins: *Proc. spinosi*.

221.

1. *Cucullaris s. trapezius*.

Pos.: on the neck and back: meets along the inner border (*proc. spin.*) with the corresponding muscle of the other side. Its external superior border bounds the *interstit. supra-claviculare*. Covers above, the *splenii*, in the centre, the *Rhomboidei*, *supra-spinatus* and *levator scapul.*, then a portion of the *extensor spinæ* and *latissim. dorsi*. Or.: 1. *Proc. spinosi* of the dorsal vertebræ and *lig. nuchæ*; 2. *Spina occipital. ext.* and *Lin. semicirc. super.* (the inner third). Ins.: *Spina Scapulæ*, *Acromion*, *Clavicula* (the outer third). Fig.: triangular, the base turned towards *Proc. spin.*; both together quadrangular. Use: to draw the shoulder backwards and inwards; the superior portion draws it upwards, the inferior downwards.

Nerves: *accessor. Willis.*, *cervical.* and *dorsalis*.

222.

2. *Latissimus dorsi*.

Pos.: below in the lumbar and sacral region; above and externally behind the cavity of the axilla. Or.: 1. From external ramus of *cristi ilei*, tendinous. 2. From the *aponeur. lumbo-dorsal.* between *crista ilei* and the twelfth dorsal vetebra, fleshy. 3. From *proc. spinosi* of the sixteenth to the nineteenth vertebræ. 4. Fasciculi from the ninth to the twelfth ribs.—All the fasciculi converge towards the axillary fossa. Ins.: *Spina tuberculi minor. oss. humeri* (2" broad), above the tendon of *m. pectoral. maj.*; behind *teres major*, united with it. Use: to draw the

shoulder down, rolling the arm inwards and behind (*m. aniscalptor*); draws the arm, when raised, downwards, or the trunk towards it, or expands the thorax.

Nerves: *dorsales*, *lumbales*, and *sacrales*.

B. Second layer.

223. Seven muscles; some covering others.—Origin: *Proc. spinosi* (except *m. levator anguli scapulæ*). Direction of fibres from within, outwards.

224. 1. *Splenius capitis*.

Pos.: oblique upwards and outwards, covered by *m. cucullaris* and *sterno-cleido-mast.* Above, before it: *trachelo-mastoid.*, *complexus*, *biventer* from without, inwards. Or.: *Lig. nuchæ* (third to the sixth vert.); *proc. spin.* (*vv.* seventh to the eighth). Ins.: *Proc. mastoideus* below *m. sterno-cleido-mast.*; and below *Linea semicircular. superior*. Use: to rotate the head, so that the face looks towards the same side; both acting together draw it directly backwards.

225. 2. *Splenius colli*.

Pos.: close to the outer side of the last muscle; covered by *cucullar.* and *serrat. post. sup.* Or.: *Vv.* 10 to 12 *proc. spin.*; connected with the last muscle. Ins.: *Vv.* first to third *proc. transv.* Use: to draw the neck (also atlas and head) towards its own side; both extend the neck.

226. 3. *Levator anguli scapulæ*.

Pos.: outside the last; above, covered by *sterno-cleido-mast.* besides by *trapezius*. Or.: *Vv.* 1 to 4 *proc. transv.* (3 to 4 heads) external to the *splenius colli*, behind the *scalen. post.* Ins.: *Scapulæ angulus superior* (between *rhomboidei* and *serrat. magn.*). Use: to elevate the internal superior angle of the *scapula* (to shrug the shoulders).

227. 4. *Rhomboideus superior s. minor*.

Pos.: transverse between *vertebræ* and *scapula*.

Or.: *Vv.* 6 to 7 *proc. spinosi* (*lig. nuchæ*). Ins.: *Bas. scapulæ labium externum* (the superior part). Use: to draw the *scapula* inwards and upwards.

228. 5. *Rhomboideus inferior s. major*.

Pos.: below the last *m.* in a similar direction. Or.: *Vv.* 11 to 13 *proc. spinosi*. Ins.: *Bas. scapulæ lab. extern.* (the infe-

rior part). Use: to draw the scapula (particularly the inf. angle) inwards, whereby the shoulder (humeral end) sinks.

229. 6. *Serratus posticus superior*.

Pos.: covered by the two preceding muscles, meeting anteriorly in the *m. scalen. post.* Or.: *Vv.* seventh to the tenth *proc. spinos.* Ins.: *Costæ* second to the fifth (superior border, in the neighbourhood of the *angulus*). Use: to draw the second to the fifth rib upwards (*m. inspirat.*).

230. 7. *Serratus posticus inferior*.

Pos.: in the lumbar region, anterior to the *m. latissim. dorsi*, united with its tendon. Or.: *Vv.* eighteenth to the twenty-second *proc. spinos.* Ins.: *Costæ* ninth to the twelfth (the inferior border). Use: to draw the ninth to the twelfth ribs backwards and downwards, and to fix them.

Nerves: (first to the seventh) *rr. posterr. nn. spinalium*.

231. C. Third layer.

Pos.: in the posterior fossa of the vertebral column, between *proc. spinosi* and *transversi*, or *anguli costarum*, separated from the layers 1 and 2 by *fasc. lumbo-dorsal*. Or.: *Proc. transversi*.

232. 1. *Biventer cervicis*.

Pos.: covered above by *diaphragm*, below by *splenii* and *serrat. sup.*; lies upon *semi-spinal cervic.* and *complexus*. Or.: *Vv.* ninth to the fourteenth *proc. transvers.* (Apex). Ins.: *Linea semicircular. superior*. (in the centre), united with *m. complex. cervic.*—The tendon between separates the superior and inferior belly. Use: to draw the head backwards and rotate it a little; both extend it.

233. 2. *Complexus cervicis*.

Pos.: outside, close to the last *m.*, covered by it, the *splenii* and *trachelo-mast.* Or.: 1. *Vv.* eighth to the tenth *proc. transv.* 2. *Vv.* third to the seventh *proc. obliqui*. Ins.: below *linea semicircular. superior*. between *trachelom.* and the central line. Use: to draw the head backwards and rotate it more strongly than the last.

234. 3. *Trachelo-mastoideus*.

Pos.: external to the last, and before it; below covered by *splenii* and *lev. scapulæ*. Or.: 1 *Vv.* seventh to the eleventh *proc. transv.* 2. *Vv.* fourth to the sixth *proc. obliq.* with seven fasciculi. Ins.: *Proc. Mastoid.* (posterior part). Use: to draw the head backwards and sideways.

235.

4. *Transversalis cervicis*.

Pos.: external to and (above) before the last; united below with *m. longissimus dorsi*. Or.: *Vv.* eighth to the fourteenth *proc. transv.* *Vv.* fourth to the seventh *proc. obliq.*, with seven fasciculi. Ins.: *Vv.* second to the sixth *proc. transv.* Use: to incline the neck sideways.

236.

5. *Cervicalis descendens*.

Pos.: lateral in the neck, before the last muscle, and behind *muscul. scalen. post.* Or.: *Vv.* fourth to the sixth *proc. transv.* Ins.: *costæ* third to the sixth (the superior border, opposite the angle). Use: to draw the neck sideways; or raise the third to the sixth ribs.

Nerves: *rr. posterr. nn. cervicall.* (from the first to the fifth).

237.

6. *Longissimus dorsi*.

Fig.: three-sided, below thick. Pos.: external to *spinal. dorsi*, internal to *ilio-costalis*, behind *multifid.*, *semispinalis*, *levator. costar.*, covered by *fasc. ilio-dorsal* and *serrati postici*, along the vertebral column, the neck excepted. Or.: tendinous from *proc. spin.* of *Sacrum* and the three inferior lumbar vertebræ, fleshy from the posterior part of *fossa ovalis oss. ilei*. Ins.: a. *internal* fasciculi to the lumbar vertebræ and *proc. transv.* of all the *dorsal*; b. *external* fasciculi to the *proc. transv.* of all the lumbar vertebræ and to the twelfth to the second ribs (the lower border). Use: to extend the lumbar and dorsal portions of the vertebral column, drawing the chest downwards.

238.

7. *Ilio-costalis* (s. *sacro-lumbalis*).

Fig.: long. Pos.: upon the *longiss. dors.* external to it, on the lumbar vertebræ and behind the ribs, ascending internally to *angul. cost.*; covered posteriorly by *fasc. lumbo-dorsal.* and *serrati postic.* Or.: a. *labium extern. crist. ilei*; b. from the origin of *longiss. dorsi* on the third to fifth lumbar vertebræ; c. from the sixth to the seventh inferior ribs (superior border). Ins.: first to twelfth ribs (inf. border of angle). Use: to draw the ribs downwards. The continuation forms *cervical. descendens*. [The origins, c, pass, also, under the name of *musculi accessorii ad sacro-lumbalem*.]

Nerves: (sixth to the seventh) *rr. postt. nn. intercostt.* and *lumball.*

D. Fourth layer.

Origins: *proc. spinos.* or *transv.* Ins.: *proc. spinosi*.

239.

1. *Spinalis dorsi*.

Pos.: between *proc. spin.* and *longiss. dorsi*; upon *multifidus*, covered by *serrati post.* Or.: *Vv.* seventeenth to the twenty-first *proc. spin.* Ins.: *Vv.* fifteenth to the ninth *proc. spinos.* Use: to extend the back.

240.

2. *Spinalis cervicis*.

Pos.: in the neck, close to *proc. spin.* Or.: *Vv.* eighth to the ninth *proc. spin.* Ins.: *Vv.* third to the second *proc. spin.* Use: to extend the neck.

241.

3. *Semispinalis dorsi*.

Pos. before *m. longissim.*; behind *multifid.*; below and internal: *spinal. dorsi*; above and external: *semispinal.* and *biventer cervicis*. Or.: *Vv.* thirteenth to the eighteenth *proc. trans.* Ins.: *Vv.* tenth to the fifth *proc. spin.* Use: to draw the back obliquely backwards.

242.

4. *Semispinalis cervicis* (s. *colli*).

Pos.: before *m. biventer*, behind *multifidus*. Or.: *Vv.* eighth to twelfth *proc. transv.* Ins.: *Vv.* fifth to the second *proc. spin.* Use: to draw the neck obliquely downwards and backwards.

243.

5. *Levatores costarum* s. *supracostales*.

a. *breves*, twelve.

Pos.: before *m. longiss. dors.* and *ilio-costal.*, and *cervic. descend.*, behind the diaphragm in the post. part of the intercostal spaces. Or.: *Vv.* seventh to the eighteenth *proc. transv.* Ins.: *Costæ*, first to the twelfth (the superior border of the posterior part). Use: to draw the ribs backwards and upwards.

b. *longi*, four.

Or.: Seventh to the tenth *proc. transv.* Ins.: ninth to the twelfth ribs.

Nerves: *rr. postt. nn. cervicall.* and *dorsall.* (from first to the fifth).

E. Fifth layer,

close upon the vertebral column in the spaces between the processes. Small muscles.

244.

1. *Rectus capitis post. major*.

Pos.: before *complexus* upon the post. arch of the *Atlas*. Or.: *Proc. spin. epistroph. (dentatus)*. Ins.: *Linea semicircular. infer.* 1" broad, near the middle line. Use: to extend the head.

245. 2. *Rectus capitis posticus minor.*

Pos.: internal and close to the last, before and covered by it.
 Or.: *Atlas (tuberc. post.)*. Ins.: *Linea semicircular. inferior.*
 [In the fossa below this.] Use: to extend the head.

246. 3. *Obliquus capitis superior s. minor.*

Pos.: external and close to the last muscles, oblique. Or.:
Atlas (proc. transv.). Ins.: *Os occiput* (between the *lin. semic. infer.* and *superior.*) behind *proc. mastoid.* Use: to draw the head backwards, or rotate it towards the opposite side.

247. 4. *Obliquus capitis inferior s. major.*

Pos.: oblique, outwards and upwards, covered by *complex.* and *trachelo-mast.* Or.: *Epistropheus* (on the side of *proc. spinos.*). Ins.: *Atlas (proc. transv.)*. Use: to rotate the *Atlas* (with the head and face) towards its own side.

248. 5. *Multifidus spinæ.*

Pos.: between the *spinous* and *transverse* processes of the entire vertebral column; immediately upon the vertebræ (and *rotatores dorsi*; covered by *longiss.*, *spinalis dorsi*, *semispin. dorsi* and *cervicis*, *complexus*. Or.: Lateral parts of the *Sacrum*; *proc. transv.* (inferior vertebræ) and *obliqui* (in the neck). Ins.: *proc. spinosi* (superior vert.). Use: the separate fasciculi rotate the vertebræ; the entire muscle extends the column.

249. 6. *Interspinales.*

In the spaces between the *Proc. spinosi*, of the cervical (second to the seventh) and lumbar vertebræ. Use: to extend the vertebral column.

250. 7. *Intertransversales.*

In the spaces between *Proc. transversi*; in the neck: *externi* and *interni* (generally wanting in the back). Use: to draw the vertebræ, and consequently the column, sideways.

251. 8. *Rotatores dorsi.*

Pos.: covered by *multifidus spinæ*, on the dorsal vertebræ, transverse. Or.: *proc. transversi* (superior border). Ins.: Arch of the vert. next above.

Nerves: *rr. posterr. nn. spinalium* (from the first to the eighth).

Fasciæ.

252. 1. *Fascia nuchæ*, between the first and second layer of cervical muscles, blends before with the *cucullar.* in the *fasc. cervical.*, behind in the *lig nuchæ*. 2. *F. lumbo-dorsalis.* a. Superficial posterior layer, connected above with the last mentioned, descends from the spinous process of the tenth vertebræ to the last Sacral, attaching itself externally and below to the *Crista Ilei*, externally and above to the *angul. post. scapulæ*; is covered above by *Mm. cucullaris, rhomboideus* and *latissim. dorsi*, below only by the skin of the back. b. Deep, anterior layer, between the twelfth rib and *crista ilei*, forms between *Proc. transv. vertebræ lumbalis* and the twelfth rib a tendinous crescentic margin, and with the superficial layer a triangular sheath for the third and fourth layers of muscles.

V. Abdominal Muscles, *Mm. abdominales.*253. 1. *Obliquus abdominis externus s. descendens.*

Pos. in front and on the side of the abdomen, close behind the skin, broad and four-sided, oblique; before the following muscles, the anterior portion of the seventh and eighth last ribs; covered on the posterior border by *latissim. dorsi*. Or.: Fifth to the twelfth ribs (with seven to eight attachments forming dentations with *M. Serratus magnus*) 2 to 3" broad from the inferior border, fleshy. Ins.: 1. the crest of the Ilium (*lab. extern.*); 2. the *linea alba*, with a wide aponeurosis. Direction of the fibres from above downwards and from behind forwards. Use: 1. contracts the abdominal cavity; 2. draws the ribs downwards, and thereby flexes the thorax; or, 3. if this is fixed, the pelvis (*m. expiratorius*).

254. 2. *Obliquus abdominis internus s. ascendens.*

Pos.: behind the last *m.* covering the following; before broader than behind, where it reaches to the spinous processes; the fleshy part at the side of the abdomen. Or.: fleshy from the anterior third of the *crista ilei* and *lig. Poupartii*. Ins.: Tenth to the twelfth rib cartilages (the inferior border); and internally, *Linea alba*, with a broad tendon. Use: the same as the preceding muscle.

255. 3. *Transversus abdominis.*

Pos.: transverse around the abdomen, from *proc. ensiform.* as far as *symphysis pubis*, on the lumbar vertebræ between *ilio-costal.* and *quadrat. lumborum*, separated from the diaphragm behind it by *fascia transversalis*. The fibres pass directly from

within outwards, connected above with the *diaphragm* and *triangularis sterni*. Or.: 1. *Cartil. costæ*, seventh to the twelfth (the internal surface); 2. *Crista ilei labium internum* (two-thirds) and *Lig. Poupartii*; 3. *Proc. transversi* of the lumbar vert. Ins.; fleshy above to *proc. ensiform.*, tendinous to *linea alba*. Use: to contract the abdominal cavity (in defecation and expiration) stronger than the two preceding muscles.

256. *Arcus cruralis*, s. *ligamentum Poupartii*, s. *Fallopia*.

The inferior sharp border, reflected backwards, of the tendon of *obliq. extern.*, which passes obliquely from without and above, inwards and downwards between *Spina ilei ant. sup.* and *symphysis pubis*, for two inches in width from *Spina Ilei*, firmly attached to the *fasc. iliaca*, and extended like a pillar, bounds anteriorly a triangular space, the posterior limit of which is formed by the *os ilei* and *pubis*. This space is filled up—commencing on the outside, with: *M. Psoas* and *iliacus*, *Nerv.*, *Art. Ven.*, *cruralis*, *m. pectineus*.

The *fascia femoris* is attached to the inferior sharp border; the free border of the reflected portion is firmly connected externally to the *fascia iliaca*, internally to the *fasc. transv.* Between the two borders lies a channel above concave, which is the floor of the *Canal. inguinalis*. It first commences on the internal border of *m. psoas*. Before the attachment to the *Symphysis pubis*, the *lig. Poupart.* divides into two crura or pillars, between which the triangular abdominal ring (*annulus abdominalis*) serves as an entrance into the inguinal canal. The superior, internal pillar, *crus internum*, broader and longer, passes away over the *Symphysis pubis* by the *Spina*, and then decussates with similar fibres from the other side. The inferior pillar, *crus externum*, is roundish, attaches itself to *Spina pubis* of its own side, and is connected with the *crista pubis* by means of:

257. *Lig. Gimbernati*, a triangular, horizontal, tendinous band (about half an inch long), the external, concave, almost sharp border of which forms the internal boundary of the *annulus cruralis*. From its superior surface a tendinous band passes to the *fascia femoris*.

258. *Annulus abdominalis* and *inguinalis externus*, abdominal, external inguinal ring, between the crura of *Lig. Poupartii* on the *Symphysis pubis*, oval or triangular, the apex directed upwards and outwards, covered anteriorly by the delicate *fasc. superficialis* [*fascia spermatica extern.*], formed behind of fibres from *obliq. intern. transversalis*, and *fasc. transv.*, is the external opening of:

259. *Canalis inguinalis* (for the spermatic cord of the male,

the round ligament in the female), which perforates the anterior abdominal parietes formed of the three preceding muscles, is $1\frac{1}{2}$ to 2" long, and passes in the direction of *lig. Poupartii*, obliquely from above, outwards and backwards, downwards, inwards and forwards. *M. obliq. extern.* forms its inferior and anterior wall, its posterior the *fasc. transv.* and tendinous fibres of *obliq. intern.* and *transv.* (towards the *annul. abdominal.*); its superior, the inferior borders of *mm. obliq. intern.* and *transv.* The interior of the canal is lined by *fasc. trans.* [*fasc. spermatica intern.*], which continues down into the scrotum as a common envelope of the spermatic cord and testicle. Behind it opens into the abdominal cavity by means of the irregular

260. *Annulus inguinalis internus* (at a distance of 2" from the *spina ilei sup.*), on the internal semilunar sharp border of which (*plica semilunaris* of the *fasc. transv.*) the *Art. epigastrica* passes upwards and inwards. Through this ring, in the mature fœtus, the testicle, together with the spermatic cord, passes out from the abdominal cavity into the inguinal canal, and thence into the scrotum. At birth the *annul. inguinal. intern.* and *extern.* lie close behind one another.

261. *Linea alba* is the white stripe found in the central line of the abdominal parietes, in which the aponeuroses of the lateral abdominal muscles are associated together (or decussate, Velpeau), which passes downwards from *Proc. ensiform.* as far as *Symph. pubis*, between the *mm. recti*, above the umbilicus 3 to 2", at it $\frac{1}{2}$ ", below it 1" broad. The navel ring, *annulus umbilicalis*, is a large (rhombic, Velpeau) opening in about [below] the centre, through which in the (new-born) infant the umbilical vessels (frequently also portions of intestine) pass. On the anterior surface the white line is stretched by the *m. pyramidalis*; on the posterior surface it is strengthened by the *lig. triangulare s. administratum lin. albæ*, the apex upwards.

Nerves: (first to the third) *intercostales, lumbales, iliohypogastricus.*

262.

4. *Rectus abdominis.*

Pos.: close to [the outer side of] the *linea alba* [on the inside of *linea semilunaris*, a curved tendinous line, extending from the cartilage of the eighth rib to the tuberosity of the *os pubis*], in the very strong *vagina recto-abdominalis*. Fig.: elongated, flat, with two to six tendinous transverse striæ, *inscriptiones tendinæ*. Or.: *Symph. oss. pubis* (with two tendons). Ins.: fifth to seventh rib cartilages (anterior surfaces), *Proc. ensiformis*. Use: to compress the abdominal viscera; to draw the sternum and the fifth to seventh ribs downwards (*exspiratio*), or, to flex the pelvis.

263. 5. *Pyramidalis abdominis*.

Pos.: before the inferior extremity of the preceding muscle, close to the *linea alba*, covered by the anterior layer of its sheath. Or.: *Symphys. pubis* (the superior border); broad. Ins.: *Linea alba*, between *umbilicus* and *symphysis*; pointed. Use: to stretch *linea alba*.

Nerves: (fourth to fifth) *iliohypogastricus*.

264. 6. *Cremaster s. tunica erythroides*.

Pos.: in front and on the side of the spermatic cord (in the *canal inguinalis*); thin, long. Or.: *Spina pubis* and *M. obliq. intern.* Ins.: *Tunica vaginal. commun. funical. sperm. et testiculi*. Use: to draw the testicle upwards, pressing the spermatic cord.

265. 7. *Quadratus lumborum*.

Pos.: along the *lumbar* vertebræ, in a strong tendinous sheath, behind the kidneys, the colon, *psoas* and *diaphragm* muscles; between the Ilium and last rib; covered behind by the tendon of transversalis. Or.: 1. *Crista ilei labium intern.* (the posterior part); 2" broad; 2. *Lig. ileo-lumbale*; 3. *Proc. transv.* of the lumbar vertebræ. Ins.: twelfth rib—the inferior border of the posterior extremity. Use: to draw the twelfth rib downwards (*exspiratio*); inclining the vertebral column sideways, or the pelvis.

Nerves: *lumbales*.

266. 8. *Diaphragma*.

This is the transverse, muscular, dome-shaped, vaulted partition which separates the thoracic from the ventral cavity. It is tendinous in the centre (*pars tendinea*), fleshy in the periphery (*p. carnosa*), which is attached to the ribs (*p. costal.*) and to the lumbar vertebræ (*p. lumbal.*).

Attachments: a. the bodies of the second to the fourth lumbar vertebræ (anterior surface).

b. *Sternum* and *Proc. ensiform.*; cartilage of the seventh to the twelfth ribs (posterior surface).

a. *Pars lumbalis* consists of six (three on each side) *crura*.

a. *Crura interna*, strong, arise from the third to the fourth lumbar vertebræ; between them lies:

aa. *Hiatus aorticus* (for aorta, *ductus thoracicus*, *vena azygos*), 3" long, 1" broad, rather to the left of the central line.

The internal crura cross each other before the parts above mentioned, and in this way form the

ββ. *Foramen œsophageum* for the (*œsophagus*, *nn. vagi*, and continuation of

the pleura), 2" long, 3 to 4" broad. The crura then pass into the tendinous centre.

6. *Crura Media* arising from the sides of the second lumbar vertebra, or from *lig. intervertebrale*, uniting above with the internal and external crura, passing into the *centr. tendin.* become perforated by *N. splanchnicus minor*. Between the central and internal crura pass through: *Nn. splanchnici maj.*; between the central and external: *Nn. sympathici*, *Vena hemiazygos* upon the left and *Vena azygos* sometimes upon the right side.

7. *Crura externa*, very short, arise from the *first lumbar vert.* (side of the body); are united with *lig. vertebro-costale* before *m. psoas*, and *quadr. lumb.*, losing themselves in the *Centr. tendineum*.

b. *Pars costalis* (and *sternalis*), see under "Attachments." Upon either side six fleshy heads from the rib cartilages and two from the *Proc. ensiformis* pass inwards towards the *Cent. tendineum*, which on the four inferior ribs are connected with *m. transv. abdom.* Quite in front is found a small triangular interspace in which the *Pleura* and *Peritonæum* come in contact.

c. *Centrum tendineum* s. *speculum Helmontii*, the central tendinous portion, in shape like a trefoil leaf, is the most elevated portion of the diaphragm, on a level with the fifth rib (at the sternum), on the right side (over the liver) arched. In it, to the right of the central line, we find the *foram. quadrilaterum* (1 to 1½" diam.), through which aperture the *V. cava inferior* ascends from the liver to the right ventricle of the heart, and the pleura and peritonæum come in contact.

The superior (thoracic) surface, which in the fœtus is much more vaulted than after birth, when the lungs have fairly respired, is covered by Pleura and Pericardium, and serves for the support of the lungs and heart.

The inferior surface is covered by peritonæum, except at the point corresponding to the obtuse border of the liver (*lig. coronar. hepat.*). On the right lies the liver, left the spleen and fundus of the stomach.

Use: the diaphragm, as it contracts, widens the thoracic and diminishes the abdominal cavity. Thus in inspiration and in the evacuation of the contents of the intestines.

Nerves: *phrenicus*, branches of *Vagus*, *lumbal.*, *intercostal.*, *sympathicus*.

Fasciæ Abdominales.

267. 1. *Fascia superficialis abdominis* covers the anterior surface of the abdominal muscles, is thin upon the fleshy parts, firmly attached and thick upon the tendinous, particularly below the navel, consists of fibro-cellular tissue interwoven with tendinous and elastic fibres; passing before the *annul. abdomin.* over the spermatic cord into the Scrotum, it goes to join the *fasc. femor. superficialis*.

268. 2. *Fasc. transv. abdominis* mounts upwards from *lig. Poupartii* between the abdominal muscles and peritonæum; is below, particularly at the *lig. Gimbernati*, the strongest where a posterior layer (from the *spina pubis* as far as the internal boundary of the internal inguinal ring) ascends almost vertically, whilst an anterior layer passes obliquely outwards and upwards, and forms the external boundary of the internal inguinal ring. (On account of the strength of this fascia internal [direct] inguinal herniæ are rare.)

269. 3. *Vagina m. recti*, passes outwards from the *linea alba*, encloses both *recti abdom.*, splits at their external border, receives between the divisions the *mm. obliq. extern., intern.*, and *transv.*, and passes over into *fasc. transversalis*. The posterior layer above (before the rib cartilages) and below becomes somewhat separated, and terminates in the centre between the navel and symphysis, with a border concave below, *linea semicircular. Douglasii*.

VI. Muscles of Anus and Perineum.

Mm. ano-perinæales.

270. 1. *Sphincter ani (externus et internus)*.

Pos.: oval, round about the inferior extremity of the rectum; about one inch high. *Sphincter ani internus* is nothing but the last (white) circle of the muscular fibres of the rectum. Or.: 1. The lowest circle, that is *externus* before the coccyx from the fibro-cellular tissue beneath the skin; 2. The superior circle from the fibrous membrane at the apex of the coccyx. Ins.: 1. In the subcutaneous fibro-cellular tissue, pointed. 2. The fibrous raphé on the anterior boundary of the *rectum*. Use: closes the anus, and assists the urethra, compressing it behind.

271. 2. *Transversus perinæi (superficialis et profundus)*.

Pos.: nearly transverse before the anus, close above the skin, behind *levator ani*; forms the posterior border of a triangle the external border of which is *m. ischio-*, the internal *bulbo-cavernosus*. It covers the *bulbus urethræ* above. *Perin. superfic.* is the posterior; *profundus* the anterior portion. Or.: *tuber Ischii* (internal surface—close below *ischio-cavernosus*). Ins.: *tuber Ischii*, the other side connected with *sphincter ani* and *bulbo-cavernosus*. Use: presses the anterior wall of the rectum towards the posterior, as in defæcation.

272. 3. *Coccygeus s. ischio-coccygeus*.

Pos.: flat, triangular at the inferior extremity of the pelvis; covered by *M. glutæus max.* at the *post.* border of the *m. leva-*

tor ani, with which it forms the floor of the pelvis. Or.: tendinous from *Spina Ischii* and *lig. spinos o-sacrum*. Ins.: *Os coccygis* (border and anterior surface), *Os sacrum* (apex). Use: assists in bending the coccyx forwards; both acting together fix it (in ejection of the semen).

273. 4. *Curvator coccygis*.

Pos.: upon the anterior surface of the coccyx, mostly tendinous. Or.: from the sides of the apex of the *os sacrum*. Ins.: apex of coccyx. Use: to bend the coccyx.

274. 5. *Extensor coccygis*.

Pos.: upon the posterior surface of the coccyx, mostly tendinous. Or.: from the apex of *os sacrum spin. ilei poster. infer.* Use: to draw the coccyx backwards.

275. 6. *Levator Ani*.

Pos.: before the preceding muscle, anteriorly narrow, behind broad; four-sided; covered by *fascia pelvis*; below, by *sphincter ani*, and behind by *M. glutæus max.*; before, by *M. obturator intern.* Between the anterior borders of the two decussating muscles and the pubic arch a longitudinal fissure remains, through which the urinary and genital organs pass out. Or.: 1. *ramus descend. pubis* (internal surface), as far as, 2. *Spina Ischii*. Ins.: 1. the sides of the *Prostata*, *urinary bladder*, and the *Rectum*. 2. the apex of the coccyx as far as *sphincter ani*. *M. pubo-urethralis*, a thin fasciculus which passes to the *urethra*. Use: draws the anus backwards and upwards, expands it (in the act of defecation), likewise the coccyx, contracting the pelvic outlet. [Or.: from a fibrous cord extending from the body of the *Pubis* to the spine of the *Ischium*.]

276. 7. *Ischio-cavernosus*, s. *erector penis*, s. *clitoridis*.

Pos.: close to the *ram. ascendens oss. ischii*; covered below by fibro-cellular tissue, above by *corp. cavernosum*; internally lies *M. bulbo-cavernosus*, separated from it by a triangular space. Or.: *tuber ischii* and *ram. ascendens*. Ins.: *Corp. cavernosum penis*; to the entire length of the *Crus*. Use: presses the root of the Penis against the bones, maintaining the already erect organ in a direction forwards; does not compress, but widens the root of *Corp. cavernosum penis*.

277. 8. *Bulbo-cavernosus* s. *accelerator urinæ* [s. *ejaculator seminis*].

Pos.: before the anus, below and along the *bulbus* and the

portio spongiosa of the urethra, which it surrounds like a kind of sheath, below covered by the skin of the perinæum. The internal borders of the two muscles meet together. Or.: *lig. perin. triangular.*, sides of *bulbus* and *corp. cavern. urethræ*, and *penis*. Ins.: *Corp. cavernosum urethræ*; *pubo-cavernosus s. levator penis*, anterior portion of *bulbo-cavernosus*; sometimes appears, isolated, between the *lig. suspensor penis* and the perinæal muscles.

[The fibres of the *larger portion* of this muscle form a canal through which the *bulbus corp. spong.* and a portion of *corp. spongiosum urethræ* pass. The origin of this portion of the muscle is the tendinous layer between *Corp. spongiosum* and the under surface of *corpora cavernosa*, whence the fibres descend, embracing the sides of the spongy body and bulb, and unite below in the central line or raphé, which posteriorly consists of very condensed tissue. The fibres of the *smaller portion* arise from the pubes by the sides of the *lig. suspensor penis*, and, descending upon the outer borders of the crura penis, from which likewise a few fibres arise, they unite in the middle line of, and beneath, the *corp. spongiosum urethræ* anterior to the fibres of the larger portion. The posterior extremity of the muscular tube is applied to the anterior surface of the deep perinæal fascia. TRANS.]

Use: to compress the *bulb. urethræ* and *corp. cavernosum urethræ*, to contract the canal of the urethra, urging forward the urine or semen by jerks, or restraining their passage.

278. 9. *Constrictor cunni s. vaginæ.*

Pos.: circular around the entrance into the Vagina. Or.: *M. sphincter ani* and *transv. perinæi*. Ins.: *Crura clitoridis* (inferior surface). Use: to contract the Vagina. [Or.: from the under surface of *crura clitoridis* meeting below, after having embraced the sides of the *vagina* and *nymphæ*.]

279. 10. *Constrictor urethræ.*

Pos.: below *lig. perinæale* about the *pars memb. urethræ*. Between it and *transv. perin. (profund.)*, the glands of Cowper. Or.: *os Ischii (ram. ascendens)*. Ins.: *isthmus urethræ* (sides). Use: to compress, and shorten the membranous portion of the urethra.

280. 11. *Vesicalis s. depressor vesicæ.*

Pos.: at the inferior part of the urinary bladder. Or.: a. *lig. pubo-vesicale*; b. *lig. ischio-prostaticum*. Ins.: close above the Prostate on the anterior and lateral surfaces of the bladder. Use: to draw the bladder downwards (for example, while making water in recumbent position).

Nerves of anal and perinæal muscles: *pudend. common.* and *hæmorrhoid.*

281.

Fascia perinæi.

The general subcutaneous fascia is connected before with *Tunica dartos* (or the fibro-cellular tissue of the labia), behind with the *sphincter ani* and *coccyx*; is near the *anus* membranous, contains fat, and is placed over the *fossa perinæi*.

282. a. The proper perinæal fascia (*f. p. superficial.*) has an anterior and a posterior segment.

1. Anterior segment (*aponeur. ischio-pubica*), from *arcus pubis* of the Ischium and pubis as far as *tuber ischii*, covers in the male: *m. transv. (superf.)*, *ischio-cavern.*, and *bulbo-cavernos.*, and passes over anteriorly upon the Penis; in the female it divides anteriorly, covers with the internal layer the *constrictor vaginæ*, reaches in the *labium min.* as far as the *clitoris*; the external lies in the entire length of the *labia majora*.

2. Posterior segment (*apon. ischio-rectalis*) connected in front with, 1.; covers the *fossa perinæi*; the internal layer covers the external surface of the *lev.* and *sphincter ani*; the external the posterior part of the *obturator intern.*, and confined below to the *tuber ischii*, *lig. tuberoso-sacrum* and *glutæus maximus*.

Fossa perinæi [Ischio-rectal fossa], a conical fossa, the base of which corresponds with the skin, is formed, anteriorly, by *transv. perin.*, behind by the inferior border of *glutæus maximus*, internally by *levator ani*, externally by *tuber Ischii*. It is filled up with fat and fibrous striæ.

283. b. *Lig. perinæale*, s. *fascia perinæi profunda*, a three-sided ligament; closes the anterior portion of the pelvic outlet (as, *levat. ani* the posterior), is perforated by the urethra; arises from os Pubis and Ischium, between *lig. arcuatum* (in front) and *m. ischio-cavernos.* (behind); below *nerv.* and *art. penis*. The anterior portion, covered with venous plexuses, lies above and at the sides of *pars membran. urethræ* (presenting an obstruction in catheterism); the posterior portion lies below the urethra.

284. c. *Fascia pelvis* lines the cavity of the small pelvis. Or.: close before *arcus pubis* ligamentous (*lig. pubo-vesicale*), $\frac{3}{4}$ inch from that of the other side, so that an oval fossa remains between the ligaments and *collum vesicæ*, where they unite; farther, from *pars horizontal.* of *os pubis*; at the superior angle of *for. obturator.* an opening remains (for *nerv.* and *vasa obturator.*); then from *linea arcuata* as far as to *symphys. sacro-iliaca*. Ins.: as far as the origin of *lev. ani* single; it then divides; the anterior portion passing on the side of the *urinary bladder*, *Prostate (vagina)*, and *rectum*; the posterior, behind the rectum, to the middle line, as far as the *os coccygis*.

VII. Muscles of the Upper Extremity.

A. On the Scapula.

285. 1. *Deltoideus, Attollens humeri.*

Pos.: envelopes like a cap the head of the upper arm and its superior third; beneath the skin; anterior, external to and behind the shoulder joint, separated from it by a tendinous layer; covers the tendons of *pectoral. major* and *minor*, *coraco-brachialis*, *biceps*, *infraspinatus*, *teres minor*, *triceps brachii*, *Vasa* et *Nn. circumflexi humeri*. The anterior border is separated from the external border of *pectoral. major* by *Vena cephalica*. Or.: *Spina scapulæ*, *Acromion*, *Pars acromialis claviculæ* (as *M. cucullaris*). Ins.: with three tendons to the extremity of *Spina tuberc. majoris oss. humeri*, almost in its centre. Use: 1. the central fibres raise the arm directly outwards and upwards; 2. the anterior forwards; 3. the posterior backwards.—The arms being fixed (as in climbing), it draws the scapulæ towards them.—Antagonist: *m. cucullaris*.

Nerves: *axillaris [circumflexus]*.

286. 2. *Supraspinatus.*

Pos.: in the *fossa supraspinata*, below *lig. coraco-acromiale*, over the roof of the shoulder joint, covered by *M. trapezius*; above *Vasa* and *Nn. supra scapulares*. Or.: *fossa supraspinata* (the two internal thirds). Ins.: *tuberculum majus* (at the highest point). The tendon is connected with the articular capsule, separated from that of *m. subscapularis* by *cap. long. bicipitis*. Use.: assists in elevation of the arm and rotation outwards.

Nerves: *suprascapularis*.

287. 3. *Infraspinatus.*

Pos.: below the spine on the posterior surface of the *scapula*, covered by *latissimus dorsi*, *cucullaris*, and *deltoid.*, and a strong fascia. Or.: *fossa infraspinata* (the entire surface). Ins.: *tuberculum majus* (the central fossa); connected with *supraspin.* and *teres minor*. Use: to rotate the arm outwards.

Nerves: *suprascapular.*

288. 4. *Teres Minor.*

Pos.: on the external border of the *scapula*, behind the *Cap. long. m. tricipitis*, before *Vasa* and *Nn. scapular. super.* above upon the capsule of the shoulder, covered by *deltoid.* Or.: *margo*

externus scapula (behind), united with the preceding muscle. Ins.: *tuberculum majus* (inferior fossa); vertical, strong tendon, 1" broad. Use: like the preceding; to draw the arm backwards, and lower it, if raised; prevents the escape of the head of the humerus backwards.

Nerves: *axillaris* [*circumflexus*].

289.

5. *Teres Major*.

Pos.: at the inferior external border of the preceding muscle, before *Cap. long. tricipitis*; assists in forming the posterior border of the axillary fossa. Or.: *Margo extern.* and *Angul. inferius Scapulæ*, united with *latissimus dorsi*. Ins.: *Spina tuberculi minoris*; two inches broad, behind the tendon of *latissimus*. Use: to rotate the arm inwards, drawing it backwards towards the central line (like *ani scalptor*).

Nerves: *axillar.* and *suprascapularis*.

290.

6. *Subscapularis*.

Pos.: on the anterior surface of *Scapula*, between the external third of which and it; cellular tissue and *Vasa* and *Nn. subscapulares*. Before it: *M. serratus ant. magn.*, *Vasa* and *Nn. axillares*, *Mm. coraco-brachial.* and *deltoides*. Or.: *fossa scapularis* (two-thirds of the surface). Ins.: *tuberculum minus oss. humeri*. Its tendon glides in the concavity of *Proc. coracoid.*, between the tendons of *M. biceps* and *coraco-brachialis*, as in a pulley. Use: to rotate the arm inwards, drawing it downwards.

Nerves: *subscapulares*.

Fasciæ Scapulæ.

291. 1. *F. supraspinata*, is firmly attached to the borders of the *fossa supraspinata*, encloses the muscle, and loses itself externally beneath *Acromion* and *Proc. coracoideus*.

2. *F. infraspinata*, fixed to the borders of *fossa infrasp.*, covers and separates the *Mm. infraspinal.*, *teres minor* and *major*; loses itself externally in the *f. brachialis*, since a superficial layer covers *M. deltoideus*, a deep, the tendon of *M. infraspinatus*, and attaches itself to the tendon of *Caput breve m. bicipitis*.

3. *F. subscapularis*; covers the muscle of the same name, and is connected on the borders of *fossa subscapularis* with the preceding and with *f. lumbo-dorsalis*.

B. Muscles of the Upper Arm.

a. *Regio humeri anterior.*

292.

1. *Biceps brachii (flexor radii).*

Position: on the anterior internal surface of the upper arm; the heads on the outer side of the axilla, between *pectoral. major* and *deltoid* before, *latissim. dorsi* and *teres major* behind; the long head before *m. subscapular.* Behind its belly: *Nerv. musculocutan., M. coraco-brachial., brachial. internus*; along the internal border: *Art., Vv. brachiales, Nerv. medianus.* Or.: 1. *Caput longum—cavit. glenoid. scapul.* (at the upper edge). 2. *Cap. breve—Proc. coracoideus* (apex). Ins.: *tuberositas radii*; the tendon is surrounded by *Supinator brevis*; an aponeurosis passes over from it into the *fascia cubiti.* Use: to flex and draw the fore-arm rather inwards; stretches the *fascia anti-brachii.*

293. 2. *Brachialis internus, flexor of the elbow.*

Pos.: behind the last muscle; upon the inner border: *N. Median., Art. brachial.,* below *M. pronator teres*; on the outer border: *N. radialis* and *M. supinator longus.*

Or.: *Os humeri* (inner surface); surrounding the insertion of *M. deltoideus.* Ins.: *Proc. coronoideus ulnæ.*

Use: flexes the fore-arm, and draws it rather outwards.

294. 3. *Coraco-brachialis (s. perforatus Casserii).*

Pos.: above, under *deltoideus*, in the centre between *pectoral. maj.* and *latissim. dorsi*, below at a similar elevation as the tendon of *deltoideus*; covers above, *Art. axillar.* and *brachial., Nn. medianus* and *musculo-cut.,* lies below to the outer side of *Art. brachialis.* Or.: *Proc. coracoideus* (apex). Ins.: *Os humeri* (inner border and centre) between *anconæus quartus* [short head of triceps] and *brachial. internus.* Use: presses the scapula and humerus towards one another; assists in drawing the arm to the chest. Antagonist to the rotators.

Nerves: (first to third) *musculo cutaneus.*

b. *Regio humeri posterior.*295. 4. *Triceps (s. brachialis externus, s. anconæus magnus).*

Pos.: on the posterior external surface of the upper arm, separated from the skin by *fasc. brachialis*, covers the *nerv. radialis*

and *art. humeri profunda*. The long head lies before *M. deltoideus*, and *teres minor*, behind *M. subscapularis*, *teres major*, *latissimus dorsi*. Or.: 1. *Caput longum* from external border of *Scapula*, close beneath the articular fossa; between *teres major* and *minor*. 2. *Cap. externum* from the external border of *humerus* to below the centre. 3. *Cap. internum* from the internal border; as far almost as the condyle. Ins.: *Olecranon* (posterior surface and lateral borders). Use: to extend the fore-arm.

Nerves: *axillaris*, *radialis*.

296.

5. *Anconæus parvus*.

Pos.: behind the elbow, short, triangular, continuation of *Cap. extern.*, *M. tricipitis*. Or.: close behind *Condylus externus humeri*. Ins.: the superior external third of the *Ulna*. Use: to extend the fore-arm.

Nerves: *radialis*.

297.

6. *Subanconæus* (of Theile).

A thin muscular fasciculus. Or.: above the *fossa intercondyl. poster.* Ins.: Capsule of the elbow articulation. Use: to stretch the capsule.

298. *Fascia brachialis s. humeri*, arises, above, from *Clavicula*, *Acromion*, and *Spina scapulæ*, internally, from the tendons of *pect. major*. and *latissimus dorsi* and the uniting tissue of the axilla, envelopes the arm and terminates at the articulation of the elbow. It consists almost entirely of circular fibres. The external surface is separated from the skin by vessels and nerves which the fascia provides with sheaths.

From the internal surface two septa (*ligg. intermuscularia*) pass off, which separate the flexor from the extensor muscles (*anconæi*), and are attached to the external and internal angles of the upper arm.

299. *Lig. intermuscul. externum* arises from the anterior border of the bicipital groove, and from the tendon of *Deltoideus*, separating the *brachialis intern.* from the *triceps*; is perforated by *nerv. radialis* and *art. brachial. profunda*, which, at their commencement, run in the posterior, then in the anterior region of the arm. *Lig. intermuscul. intern.* by *nerv. ulnaris*, which runs first before, then behind it. The particular sheaths which pass off from these two large ones are:—

1. For *M. deltoideus*, arises from the posterior border of bicipital groove below *teres major*, and from the tendon of *coracobrachialis*; is thicker and triangular. 2. Sheath between *M. biceps* and *brachialis intern.* 3. *Canalis brachialis*, for *Vasa*

brachialia and *nerv. medianus*, forming on the inner side, below the centre of the upper arm a semilunar fissure, receives *Ven. basilica* and *Nn. ulnaris* and *cutaneus intern.*, and connects the uniting tissue of the axilla with that at the bend of the elbow. 4. Sheath for *caput long. m. tricipitis* at the superior half. It is stretched by *m. pectoral. maj.* and *latissim. dorsi*.

B. Muscles of the Fore-arm.

a. On the anterior or flexor surface.

a. First layer.

300. 1. *Pronator radii teres*.

Pos.: oblique from above to below, from within to without; external to *M. palmar. long.* and *flex. carp. radialis*; covered by *N. median.* and *Art. ulnaris*. Or.: *Condylus internus humeri* [and ulnar border of coronoid process]; externally *M. brachialis intern.* and *biceps*. Ins.: Centre of the *radius* (in front and on outside) covered by *M. supinator longus*. Use: rotates the radius inwards. [*Nerv. median.* perforates the muscle.]

Nerves: *medianus*.

301. 2. *Flexor carpi radialis* (s. *radialis internus*).

Pos.: next to the last described muscle, internally; with a strong tendon projecting out beneath the skin, on its external border the *Art. radialis* (Pulse). Or.: *Condyl. intern. humeri*; internal to *M. pronat. teres*. Ins.: Basis of *os. metacarp. II*. Use: to flex the hand towards the radial side.

Nerves: *medianus*.

302. 3. *Palmaris longus* (sometimes wanting).

Pos.: the spindle-shaped belly in a groove upon *flex. digitor. sublim.*, and close to the last muscle, internally, with a long superficial tendon in a strong sheath. Or.: *Condyl. intern. humeri*. Ins.: *Aponeurosis palmaris*. Use: stretches the *aponeurosis palmaris* and flexes the hand.

Nerves: *medianus*.

303. 4. *Flexor carpi ulnaris* (s. *ulnaris internus*).

Pos.: on the inner border of the *Ulna. Art. ulnaris* at first beneath it, then along the outer border of its tendon. Or.: *Condyl. intern. humeri*, and *Olecranon* (internal border; beneath it *nerv. ulnaris*). Ins.: *Os pisiforme*. Use: to flex the hand towards the ulnar side.

Nerves: *ulnaris*.

β. Second layer.

304 5. *Flexor digitorum communis sublimis* (s. *perforatus*).

Pos.: beneath the four muscles last described. Covers the following muscle and *nerv. medianus*; passes under *Lig. carpi volar. propr.* The four tendons are perforated in the region of the first phalanx by those of the following muscle. Or.: 1. *Condyl. intern. hum.* 2. Inner side of *Proc. coronoid. Ulnæ*. 3. Anterior border of *Radius*. Ins.: Lateral surfaces of *Phalanx II.* of the second to the fifth finger. Use: to flex the second phalanx of the second to the fifth finger.

γ. Third layer.

305. 6. *Flexor digitorum communis profundus* (s. *perforans*).

Pos.: beneath the before mentioned muscles, covering the *Ulna*, in the palm of the hand, the *Mm. interossei* and *adductor pollicis*. Or.: 1. *Angulus intern. Ulnæ* (above and internally). 2. *Lig. interosseum* (two-thirds). Ins.: *Basis Phalang. III.* of the second to the fifth finger. Use: to flex the ungual phalanx of the second to the fifth finger.

Nerves: (5) *medianus*, (6) *median.* [et *ulnaris*].

306. 7. *Flexor Pollicis longus*.

Pos.: external and close to the last muscle; covers the *radius* and *lig. inteross.* Or.: 1. *Margo intern. Radii* (three-fourths). 2. *Lig. interosseum*. Ins.: *Basis Phalang. II.* of the thumb. Use: to flex the ungual phalanx of thumb.

Nerves: *interosseous internus*.

δ. Fourth layer.

307. 8. *Pronator quadratus*.

Pos.: at the inferior extremity of the anterior surface of the forearm, close upon the bones, beneath *Artt. radialis* and *ulnaris*. Or.: *Angul. intern. Ulnæ* (the lower fourth). Ins.: *angul. anticus* et *Marg. intern. Radii*. Use: rotates the inferior extremity of the radius upon the ulna, thus pronates the hand.

Nerves: *interosseous internus*.

b. Muscles upon the outer surface of the fore-arm.

308. 9. *Supinator longus* s. *brachio-radialis*.

Pos.: between the volar and dorsal surface of the arm; in the upper arm, internal and close to it, *brachial. intern.*, separated by *nerv. radial.*, then upon it; covered by the skin, upon *pronat. teres*, *flex. pollic. long.*, along the inner border, upon the fore-

arm, *Art. radial.*, which commences beneath it. Or.: 1. *Marg. extern. oss. humeri* (inferior one-fourth). 2. *Lig. intermuscular.* and *Condyl. extern.* Ins.: *Basis proc. styloid. Radii.* Use: rotates the radius outwards until, at last, it rather flexes the forearm.

Nerves: *radialis, inteross. extern.*

309. 10. *Extensor carpi radialis longus* (s. *radialis externus longus*).

Pos.: For two-thirds of its length covered above by the last muscle, above and upon the carpus by *M. abductor* and *extensor pollic. long.*, on its inner edge passes *Art. radial.* Or.: *Angul. externus humeri*—*Lig. intermusculare externum.* Ins.: *Os Metacarpi II.* (Basis, dorsal surface).

310. 11. *Extensor carpi radialis brevis.*

Pos.: beneath the last muscle, covers the outer surface of the Radius; to the inner side of *m. extensor digit. commun.* Or.: 1. *Condylus extern. humeri.* 2. *Fascia cubiti.* Ins.: *Os metacarpi III.* (Basis, dorsal surface). Use: to extend, like the former muscle, the hand, and draw it towards the radial side (that is, it abducts it).

Nerves: (tenth and eleventh) *radial. superfic.* and *profund.*

311. 12. *Supinator brevis.*

Pos.: broad, on the superior half of the *radius*, winding around it, obliquely from above downwards; beneath *anconæus parvus*, *extensor digit. commun.* and *carpi ulnar.* Or.: 1. *Lig. laterale extern.* 2. *Margo extern. Ulnæ* (below fossa sigmoid.). Ins.: *Radius* (anterior inner surface one half). Use: rotates the upper half of the *radius* outwards.

Nerves: *inteross. extern.* [This muscle is perforated by a branch of the radio-spiral nerve.]

c. Muscles upon the dorsal surface.

α. Superficial layer.

312. 13. *Extensor digitorum communis.*

Pos.: between *m. extens. carpi radial. breve* and *ulnaris*, covers *M. supinat. brevis*, *abduct. long.* and *brevis*, *extensor long. pollicis*, *extens. indicis*, the back of the carpus, the metacarpus, and fingers. Or.: *Condyl. extern. humeri.* Ins.: *Phalang. II.* and *III.* of the second to the fifth finger; four tendons, each of which divides into three portions. The tendon of the second finger is more free than the rest. Use: to extend the second, third, fourth, and fifth fingers.

Nerves: *inteross. extern.* and *radial. dorsal.*

313. 14. *Extensor digiti minimi proprius*.

Pos.: internal and close to the former, to the outer side of the following muscle. Or.: united with the former muscle from *Condyl. extern.* Ins.: united with the tendon of the *M. extens. commun.* on the fifth finger. Use: assists in extending the fifth finger. This muscle is often wanting.

314. 15. *Extensor carpi ulnaris* (s. *ulnaris externus*).

Pos.: on the ulnar border, covers the *Ulna*, *M. supinat. brevis*, and the deep layer. Or.: *Condylus externus humeri* and the *Ulna* (the central third of the posterior border). Ins.: *Basis oss. metacarpi V.* Use: to extend the metacarpus and draw (adduct) it rather inwards.

β. Deep layer.

315. 16. *Abductor pollicis longus* [*Extens. primi internodii*].

Pos.: the most external, covered by *extens. com.*, upon *lig. inteross.*, *Radius*, the tendons of *Mm. extens. radial.* and the outer side of the carpus. Or.: 1. *Crista ulnæ* (below *supinator brevis*) on the second fourth. 2. *Lig. inteross.* and *Radius* (posterior surface). Ins.: *Basis oss. metacarp. I.*, the free tendon in a sheath. Use: to draw the thumb from the other fingers; assists in extending the hand and drawing it backwards.

316. 17. *Extensor pollicis brevis* [*Ext. secundi internodii*].

Pos.: internal, and close to the former muscle, only separated from it by a tendinous sheath. Or.: 1. *Angulus extern. Ulnæ*. [?] 2. *Lig. inteross.* and *Radius*. Ins.: *Basis Phalang. I. pollicis*. Use: to extend the first phalanx, and then abduct the *Oss. metacarpi I.*

317. 18. *Extensor pollicis longus* [*Ext. tertii internodii*].

Pos.: between *abduct. longus* and *extens. brevis pollic.* Its tendon crosses over *extens. radiall.* (tendons), and is, on the *carpus*, separated from the tendon of *abductor longus* by a fossa. Or.: *Ulna* (external surface, inferior half) and *lig. inteross.* Ins.: *Basis phalang. II. pollicis*. Use: extends the ungual phalanx of the thumb.

318. 19. *Extensor indicis proprius*.

Pos.: along the inner border of the former muscle, below it and *m. extens. carpi ulnar.* and *digit. commun.* Or.: *Ulna* (external angle, middle) and *lig. inteross.* Ins.: the inner side of the tendon of *extens. comm.* of second finger, on the second and third phalanx. Use: to extend the index finger.

Nerv. (fourteenth to nineteenth) *interosseus externus*.

319. *Fascia antibrachii* s. *vagina cubiti*, passes off from the *f. brachii*, enveloping the entire fore-arm as far as the *Crista ulnæ*, serving at the upper part more especially for the attachment of muscles. Fibrous striæ serve to strengthen it which come off behind, from the *triceps*, on the outside, from *brachial intern.*, and in front and internally from *biceps*, as well as those from the condyles of the *Humerus*. *Aponeurosis bicipitis* passes over *pronator teres* like a bridge at the bend of the arm, from the outer border and the anterior surface of *Biceps* tendon, inwards and downwards; covering *art. brachialis*. Besides several vascular and nervous openings, one should be observed in the *fascia antibrachii* at the bend of the arm (on the outer border of *aponeurosis bicipitis*), through which the uniting tissue beneath the skin communicates with that under the *fascia*, and which leads to a fossa in which the following parts are situated: Tendon of *m. biceps*, *Art. brachialis*, commencement of *Art. radial.*, *Nerv. medianus*. The fossa is formed: on the outside by *supinator long.*, *extensores carpi radial.*, *flexor sublimis*; on the inside by *pronator teres*; and communicates above with the canal of the *Art. brachial.*, below with those of the *Art. radial.*, *ulnaris*, *interossea*, and *Nerv. medianus*. In consequence of the attachment of the *f. antibrachii* to the internal angle of *Radius* and the internal surface of *Ulna*, a sheath arises from the muscles of the *Volar* and another for those of the *Dorsal* surface, and besides, by inversions, sheaths for the individual muscles.—At the Carpal articulation it forms,

320. a. *Lig. carpi volare*; arises internally, 1. from *Os pisiforme*, 2. from *Os hamatum*, and continues externally, as it passes over before the *Volar* surface of the carpus, to the *Os naviculare* and *Trapezium*. Behind it lie, with one (or two) synovial capsules, the nine tendons of the flexor muscles and *nerv. medianus* in one bundle. Its superficial layer, *lig. carpi volare commune*, is thin, its deep layer, *lig. carpi volare proprium*, strong. From both the *aponeurosis palmaris* springs.

321. b. *Lig. carpi dorsale commune*, very fibrous, passes obliquely from *crista radii* over the *radio-ulnar* articulation to the *os triquetrum* and the basis of the five metacarpal bones, and then passes into the *fasc. manus dorsalis*. Prolongations which pass off from the internal surface of *Lig. dors.* form the following tendinous sheaths, from without inwards: 1. for *abductor long.* and *extens. brevis pollicis*. 2. and 3. for *extens. carp. radiales* and *extens. pollicis longus* (associated together below in one sheath). 4. for *extensor digitor. commun.* and *indicator*. 5. *extens. digiti V. proprius*. 6. for *extensor carpi ulnaris*.—Each tendon enjoys its own synovial capsule.

D. Muscles on the Hand.

321. ^{vis.} a. Muscles of the ball of the Thumb (*thenar*).

a. Attached to the outer side of *Os Metacarpi I.* or *Phalanx I.*

322. 1. *Abductor pollicis brevis*.

Pos.: the most superficial on the outer border of *os metacarp.* *I.*, separated from *opponens* beneath it, by a *fascia*. Or.: *Lig. carpi volare propr.* (radial side) *Tuber Trapezii*. Ins.: *Basis of I. phalanx*. Use.: abducts the thumb from the index finger.

323. 2. *Opponens pollicis*.

Pos.: beneath the former muscle; internal portion only covered with skin; above *flex. pollicis brevis* and tendon of the *longus*. Or.: like the former muscle. Ins.: Radial border of *os metacarp. I.* Use: to draw the thumb inwards and forwards (towards the little finger).

324. 3. *Flexor pollicis brevis*.

Pos.: oblique downwards and outwards, on the external border covered by *abduct. brevis*, on the internal united with *adduct. pollicis*. Or.: the same as before, and from the tendinous sheath of *flexor radial carpi*. Ins.: *Os sesamoideum externum* and *Phalanx I.* (covered externally by the tendon of *adduct. pollicis*). Use: to draw the phalanx inwards and forwards (*M. opponens internus*).

β. Attached to the Ulnar side of the first phalanx of the Thumb.

325. 4. *Adductor pollicis*.

Pos.: triangular, between *Os metacarpi I.* and *II.*, covered by the tendons of *flexor dig. prof.* and *lumbricales*. The deep portion (*Cap. profund. M. flex. poll. brev.*) close to the former muscle; the superficial close beneath the skin. Or.: 1. *Os metacarpi III.* (the entire anterior border). 2. *Os trapezium* (anterior superior part). Ins.: *Os sesamoideum internum* and *Phalanx I.* Use: to draw the thumb towards the index finger.

Nerves: (first to the fourth) *medianus* and *ulnaris*.

b. Muscles on the ball of the little finger (*hypothenar*). Attached to the ulnar side.

326. 5. *Abductor digiti minimi*.

Pos.: on the internal (ulnar) border of *Os metacarpi V.*, covers *oppon. dig. V.* Or.: *Os pisiforme* and *aponeurosis* of

M. flex. ulnar. carpi. Ins.: *Basis phalang. I. digiti V.* Use: to draw the little finger inwards (that is to say, from the fourth finger).

327. 6. *Flexor digiti V. brevis.*

Pos.: on the outer border of the last muscle, separated from it by *Vasa* and *Nn. ulnares.* Or.: *Os hamatum* (the *process. unci-form.*) and *lig. carp. vol. propr.* Ins.: *Basis phalang. I. digiti V.* Use: to flex a little the first phalanx of the fifth finger.

328. 7. *Opponens digiti V.*

Pos.: covered by the last muscles, above the *interosseus* and the tendon of *flex. digit. comm.* of the fifth finger. Or.: *Os Hamatum* (the process). Ins.: *capitulum* and the whole ulnar side of *os metacarpi V.* Use: to draw the fifth metacarpal bone outwards and forwards (that is, towards the thumb in making the hand hollow).

Nerves: (fifth to the seventh) *ulnaris r. profund. volaris.*

c. Muscles in the middle of the palm of the Hand.

329. 8. *Palmaris brevis*, Cutaneous muscle of hand.

Pos.: close beneath the skin, in the fat over the muscles of the little finger and *Art.* and *Nerv. ulnaris*; transverse, one inch broad and long. Or.: *Aponeurosis palmar. media.* Ins.: the skin of the ulnar border, from *os pisiforme* onwards. Use: wrinkles the skin on the ball of the little finger.

Nerves: *ulnaris r. sublimis volar.*

330. 9. *Lumbricales.*

Pos.: beneath *Aponeurosis palmaris* on the four tendons of the *flexor digit. profundus*, in the hollow of the hand. Or.: the radial side of the three tendons of *flex. profund.* Ins.: the radial side of first phalanx of the second to the fifth finger; blending with the tendons of *extens. digitor. communis.* Use: flexes the first phalanx of the second, third, fourth, and fifth fingers.

Nerves: *medianus*, for the fourth *ulnaris r. superfic.*

331. 10. *Interossei volares s. interni*, 3.

Pos.: in the spaces between *Ossa metacarpi*, second to fifth, in the palm, covered before by the flexors, behind by the *m. inteross. dorsales.* Or.: sides of *os metacarpi* (two-thirds of the anterior surface) *II., IV., V.* Ins.: Phalanx *I.* of second (ulnar side), fourth, and fifth (radial side) fingers, and the tendon of *m. extens. digitor. communis.* Use, to draw the second, fourth, and fifth fingers towards the middle finger.

332. 11. *Interossei dorsales s. bicipites*, 4.

Pos.: in the spaces between *Oss. metacarpi I.* to *V.*, to be seen from the back and palm of the hand. Or.: sides of *Ossa metacarpi II.* to *V.*, with two heads, which *Art. perforans* separates. Ins.: 1. on the radial side of Phalanx I. of index finger; 2. the same on the middle finger; 3. on the Ulnar side of the middle finger; 4. the same on the ring finger. Use: draws the Index from the Middle finger, the Middle finger from the Ring and Index, the Ring finger from the Middle; they spread out the second and the fourth from the middle finger.

Nerves: *ulnaris r. profund. volar.*

333. 1. *Aponeurosis palmaris*, close beneath the skin of the hollow of the hand, it forms a sheath for all its muscles. The central portion is triangular and strong, arises from the anterior surface and the inferior border of *Lig. carpi volare* and the tendon of *palmaris longus* (between the two points *Art. ulnaris* enters into the palm of the hand); it divides in the region of the *Capitul. oss. metacarpi* into eight parts for the second to the fifth fingers, and is strengthened by transverse fibres. By this four arches arise for the tendons of *Mm. flexores*, and three between them for *Vasa* and *Nn. collaterales* of the fingers and *Mm. lumbricales*. Loose uniting tissue separates the middle part from the subjacent structures: *Arcus arterios. superficial. volæ*; *Nn. median.* and *ulnaris tendin. mm. flexor.* Externally, as a continuation of the tendon of *abductor pollicis longus*, the external portion of the *Aponeur. palm.* envelopes the muscles of the ball of the thumb; internally, as a process of the tendon of *flexor carpi ulnaris*, the inner portion, the muscles of the ball of the little finger; here the *m. palmaris brevis* is connected. It loses itself on the first phalanx in the sheaths of *flexor digit.* and *ligg. capit. os. metacarpi.*

334. 2. *F. dorsalis manus.*; a. the superficial is a thin layer, covering the tendons of *extens. digitor. comm.*, and attached to the *second* and *fifth metacarpal bones*; b. the deep, covers the *interossei*, and attaches itself to *all the metacarpal bones*, consisting of loose elastic uniting tissue, which serves instead of synovial capsules.

335. 3. Pulleys (*trochleæ*) of the *flex. digitor. comm.*; consist of fibro-cartilaginous portions with transverse fibres, lying transversely before all three phalangeal articulations of the second to the fifth fingers. On the first joint they form a connected flat surface (one inch long), to which the aponeurosis palmar. is attached.

336. Tendinous sheaths of the flexors on the fingers; they consist of separate ligaments, as :

1. Transverse ligaments, *annuli*, narrow, passing before each joint transversely in front of the tendons, attached to the *basis phalang.* and the pulley.

2. Ligamentous sheaths; broader, transverse before the bodies of the first and second phalanx.

3. Crucial ligaments, *ligg. cruciata*, before the first and second phalanx, descending obliquely from the edges of the body to the *capitulum* of the phalanx.

VIII. *Muscles of the Inferior Extremity.*

A. Muscles of the Thigh.

337.

1. *Flexor Femoris.*

a. *Psoas Magnus* (Internal Head).

Figure: at commencement flat, then round and spindle-shaped. Pos.: on the sides of the bodies of the lumbar vertebræ, between the external and central crura of the diaphragm, before *plex. lumbalis*, *quadratus lumborum*, behind the kidneys, then on the boundary between the great and small pelvis, covered by peritonæum; on the outer side *nerv. cruralis* passes. Behind it meets with *quadratus lumborum*. Or.: first to the fifth lumbar vertebræ (lateral surface of bodies). Ins.: *Trochanter minor*. The tendon passes in front of the hip-joint (with a synovial capsule).

338.

b. *Iliacus* (External Head).

Fig.: broad, three-sided. Pos.: fills up the whole *venter Ilii*, covered by a fascia, fat and peritonæum. Passes out from the pelvis, united with *psoas*, in a groove between *spina ilei anter. infer.* and *eminent. pectin.*, underneath *lig. Poupart*. Upon it, to the right, are placed the *cæcum* and the *termination* of the *small intestines*; to the left, the *colon*. Or.: *Fossa Iliaca* and *lig. ileo-lumbale*. Ins.: *Trochanter minor*.

On the thigh they lie, both united together, behind *n. cruralis* (in one sheath), internal to *Sartorius* and *rectus femoris*, external to the *adductores* and *art. cruralis*. Use: to elevate (flex) the thigh towards the trunk, or to bend the trunk forwards over the thigh.

Nerves: *cruralis* and *plexus lumbalis*.

339.

2. *Psoas Minor* (often wanting).

Pos.: on the internal border and before the lumbar portion of the former muscle, the tendon on the inner edge of *fascia iliaca*, crossing the *Psoas major*. Or.: bodies of last dorsal and first

lumbar vertebræ. Ins.: *Fascia iliaca* at the posterior part of *linea arcuata*. Use: stretches the *fasc. Iliaca*; may flex the pelvis towards the trunk (as in climbing), or draw the trunk sideways.

340.

3. *Glutæus maximus*.

Pos.: one inch thick, close beneath the skin of the buttocks; broad, four-sided; covers *glut. med.*, *pyriform.*, *gemelli*, *obturat. intern.*, *quadrat. femor.*, *incisura ischiad. maj.*, *tuber ischii*, *Mm. semitendin.* and *membranos.*, *cap. long. bicipit.*; *trochanter major*, *adductor magn.*, *Nn. et vasa glutæa*, *ischiad.*, *pudenda interna*. Or.: 1. posterior surface of Ilium, behind *lin. semicircul. poster.* 2. *spina ilei poster. super.* as far as *cornu sacrale*. Ins.: *Linea aspera*, the external crus, close under *trochanter major femoris*, and *fascia lata*. Use: extends the thigh backwards, draws and rotates it outwards; or draws (when standing upon one leg), the pelvic half of the other side, backwards; stretches the *fascia lata*, and maintains the *os. coccygis* in its situation.

Nerves: *glutæus infer*.

341.

4. *Glutæus medius*.

Pos.: behind the last, covered before and above by fat and skin, and rather by *m. fasciæ latæ*. Along the posterior border, *m. pyriform.*; on the outside, *Vasa* and *nerv. Glutæi*.

Or.: *fossa Iliaca externa*; the anterior portion from *Spina oss. Ilei anter sup.* and (three fourths) *Crista ilei*: the posterior from *linea semicircula superior*. Ins.: *trochanter major* (from the apex to the base). Use: extends and abducts the thigh; the anterior portion rotates it inwards (and helps to flex it).

Nerves: *glutæus superior*.

342.

5. *Glutæus minimus*.

Pos.: Three-sided; covered behind, slightly, by *pyriformis*, above by *vasa glutæa*, entirely by *glutæus med.*, meets anteriorly with *tensor fasciæ*, covers the upper part of the capsule of the hip joint. Or.: *fossa iliaca externa* below *linea semicircul. infer.*; *Crista Iliaca* (anterior portion), *incisura ischiadica* (external portion). Ins.: *trochanter major* (anterior surface). Use: draws the thigh directly outwards; the anterior portion rotates it inwards, the posterior outwards.

343.

6. *Pyriformis*.

Pos.: covered by *glut. med.*, in the *incisura ischiadica major*, almost horizontal along the lower border of *glut. med.*; in the

pelvis, behind the *rectum*, *Plex. ischiadic*, *Vasa hypogastrica.*; outside, behind the hip joint; at the superior border, *Vasa* and *Nn. glutæi*.

NOTE. The superior border commonly reaches the top of the *incisura ischiad.*; between it and the bone the *hernia ischiad.* passes through.

At the inferior border, *Vasa* and *Nn. ischiatici*. Or.: 1. *Os sacrum* (anterior lateral surface, close to *foramina sacral. ant.* second and third, the *n. ischiad.*). 2. *Lig. sacro-tuberos.* (anterior surface). 3. *Incisura ischiadica*, superior part. Ins.: *Trochanter major* (superior edge of the fossa).

Nerves: *glutæus superior* and *ischiadicus*.

344. 7. *Obturator internus*.

Pos.: triangular, in the pelvis, behind *membrana obturatoria*, covered before by *fasc. pelvis* and *levator ani*; passes through *incis. ischiad*, *min.* around *os ischii* and horizontally outwards, in the groove between *gemelli*, behind the neck of the *femur*, covered by *glutæus max.* Or.: *membr. obturatoria* and the whole circumference of *foram. obturatorium*. Ins.: *trochanter major*, the *lin. intertrochant. post.*, below *pyriformis*.

Nerves: *Ischiadicus*.

345. 8. *Gemellus superior*.

Pos.: above the tendon of the last muscle, horizontally outwards. Frequently wanting. *Glutæus max.* covers both *gemelli*. Or.: *Spina Ischii* (inferior border, external surface). Ins.: like the last muscle.

346. 9. *Gemellus inferior*.

Pos.: stronger, below the tendon of *obturator intern.* Sometimes double. Or.; *Tuber ischii* (quite above *lig. tuberoso-sacr.*) Ins.: like the last muscle. Uses: (of 6. to 9.), they rotate the thigh outwards.

Nerves: *ischiadicus*, for 8. and 9.

347. 10. *Quadratus femoris*.

Pos.: transverse, immediately below 9.; covers before *obturator extern.* and *trochanter minor*; between *tuber Ischii* and *trochanter major*, covered by *Glutæus max.* Or.: *tuber ischii* (external border) covered by *semi-membranos.*, *adductor magnus*. Ins.: the vertical line between *basis trochant. major* and *linea aspera*. Use: rotates (even the flexed) thigh outwards; rotates (when standing upon one leg) the trunk to the other side.

Nerves: *ischiadicus*.

348.

11. *Obturator externus.*

Pos.: behind the last muscle and *pectinæus*, *adductor brevis*, *psoas* and *iliacus*; before, *foram. obturator.* and *collum femoris*; meets above and externally, *gemellus infer.* Or.: *foram. obturator* (anterior circumference). Ins.: fossa of *trochant. major* (the lowest part). Use: rotates the thigh outwards; assists in flexing the trunk.

Nerves: *obturator.*

349.

Fascia iliaca, s. lumbo-iliaca,

envelopes *mm. psoas* and *iliacus*, arises from the lumbar portion of the diaphragm above, from the bodies of the lumbar vertebra internally, from *labium intern.* of *ilium* and the *linea arcuata* of the pelvic cavity outwards as far as *crista pubis*. a. The external portion divides between *spina ilei ant. superior*, and the outer angle of the femoral ring into an anterior and posterior layer (between which the *Vasa circumflexa ilei* pass). 1. The anterior layer turns upon the posterior surface of the abdominal muscles, and above passes into the *fasc. transv.* 2. The posterior layer unites with the outer portion of *lig. Poupartii* (that is, *fasc. ilio-pubica*). b. The internal portion descends over the *m. psoas-iliacus* upon the thigh, and unites externally with *fasc. femoris*.

B. Muscles of the Thigh.

a. On the posterior surface.

350.

1. *Biceps femoris s. flexor fibularis.*

Pos.: on the outer part of the thigh; its long head covered above by *Glutæus max.* and skin; lies upon the short head, *adductor magnus*, and behind *semi-tendinosus*; the short head on *vastus externus*, in the lower half of the thigh, then behind the popliteal vessels. Forms the outer border of the popliteal space. Or.: 1. *Caput long.* from *tuber. Ischii*. 2. *Caput breve* from *linea aspera oss. femor.* Ins.: *Capitulum fibulæ* (and *condylus externus tibiæ*). Use: flexes the leg, and accordingly by means of the long head it extends the thigh. The short head rotates the leg outwards.

351.

2. *Semitendinosus.*

Pos.: covers the following muscle between it and *cap. long. bicip.*; its long tendon is, at the commencement, behind, then between the following muscle and *gastrocnem. internus*. The tendon commences four or five finger breadths above the knee-joint, winds around the *condyl. intern. tibiæ* forwards, behind the *tendo sartor.*, on the inferior border of *tendo gracilis* ("pes anse-

rinus" tendinosus). Or.: *tuber ischii* (united with *biceps*). Ins.: *spina tibiæ* (internal surface of superior extremity) and *fasc. cruris*. Use: like the last muscle: in semiflexion it rotates the thigh a little inwards.

352.

Semimembranosus.

Pos.: before the last muscle, behind *adduct. magn.*, *gastrocnem. intern.*, *art.* and *ven. poplitæa*. Along the outer border, *art.*, *ven. poplitæa*, *nerv. ischiadicus*; on the internal border, *gracilis*. Or.: *tuber ischii* (the highest, external part, before *biceps* and *semitendinosus*). Ins.: *Condyl. intern. tibiæ*. Use: like the last muscle.

Nerves: (first to third) *ischiadicus*.

REMARK. Between *semimembranosus* (within) and *biceps. fem.* (without) a longitudinal space exists along the whole posterior surface of the thigh, in which the uniting tissue of the pelvis, by means of the *incisura ischiad. major.*, communicates with that of the *popliteal region*.

b. Upon the outer surface.

353.

4. *Tensor fasciæ latæ (Fascialis)*.

Pos.: in the upper third; inside the thick envelope of the thigh, on the outer border of *Sartorius* and *rect. femor.*; covers *glut. med.*, *minim.*, and *vastus extern.* Or.: *Spina ilei anter. super.* as far downwards as *spina ilei infer.* Ins.: *fascia lata femor.* This is attached to the *condyl. extern.* and *Spina tibiæ*. Use: maintains *vastus ext.* in its situation; rotates inwards, and abducts the thigh.

[Nerve: *Glutæus superior*.]

c. On the anterior surface.

354.

5. *Sartorius* (s. *longus*, because the longest muscle in the body).

Pos.: the longest muscle, Sigmoidal, from the outer side of the thigh to the inner of the knee, under the skin; forms at the superior third of the thigh with *pectinæus* an isosceles triangle (base, above), in the centre of which lies *Art. cruralis*. In the second third *Art. cruralis* at first passes on the internal edge, then on the posterior surface, and lastly on the external edge. In the last third it lies between *gracilis* and *vastus internus*; under the anterior edge the *n. saphenus* passes forth, on the posterior *Ven. saphena* (near the knee-joint). Above between *tensor fasciæ* and *iliacus*, then upon *rect. femor.*, *adduct. long.*, *vast. intern.* and *gracilis*. Or.: *Spina ilei anter. super.* (and rather below this). Ins.: *Crista tibiæ labium internum* (below *lig. patellæ*, before *tendd. mm. semitendin.* and *gracilis*). Use: flexes at the same

time thigh and leg (in squatting) or both alone. It only slightly assists in crossing the legs (the position of tailors when at work).

Nerves: *cruralis*.

355.

6. *Extensor cruris*.

Or.: see *a.* to *d.* Ins.: the tendinous expansion around the *patella*; *tendo extenso cruris*. Use: to extend the leg or thigh (when the one or the other is fixed, as in rising from the sitting to the standing posture).

[REMARK. To examine the insertion accurately, make a vertical section of the tendon, *patella*, and *ligam. patellæ* in the centre. TRANS.]

a. Rectus femoris.

Pos.: vertical in the centre of the thigh, between *Spina ilei anter. super.* and *patella*; above rather covered by *Sartorius*, in general by the skin. Covers above the flexor, below the three following muscles. Or.: from superior border of *acetabulum*; from *Spina ilei anter. infer*.

b. Vastus externus.

Pos.: behind the last, externally covered by skin, before *cruralis*. Or.: *trochanter-major* and *labium externum lineæ asperæ* (superior half).

c. Vastus internus.

Pos.: on the inner part of the thigh, grooved; behind, the inferior extremities of the *adductores* lie upon it. Or.: from *labium intern. lin. asperæ*, before *m. adductores* (from *trochanter minor*) as far as the inferior fourth of the thigh.

d. Cruralis.

Pos.: close upon *os femoris*, surrounded as if in a capsule by *vastus externus* and *internus*. Or.: *os femor.*, close under *vastus intern.*, as far as above *condylus intern. femoris*. The lowest fasciculi have been named *Subcruralis*.

Nerves of *extensor fem.*: *cruralis* (for *vast. intern.*), besides, *nerv. obturatorius*.

d. Internal surface.

356.

7. *Gracilis*.

Pos.: close under the skin, directly downwards; covers the *adductores*, below *semitendinos.*; at the inferior extremity of the internal surface crossed by *Ven. saphena interna*. Or.: from *Spina pubis ram. ascend. oss. ischii*. Ins.: *Crista tibiæ* (within and above), below *tendo Sartorii* and above *tend. semitendinosi*.

The long tendon winds around the *condyl. intern. femoris* (and *tibiæ*). Use: flexes the leg, and draws it inwards.

Nerves: *obturatorius* (for the seventh to the tenth). [Except the eighth. —TRANS.]

357. 8. *Pectinæus* (*adductor superficialis I.*).

Pos.: on the upper, anterior and inner part of the *femur*, on the inner border of *flex. femoris* (and *Art. cruralis*), at the external border of *adductor longus*; before the *foram. obturator, m. obturator extern.* (*Vasa obturatoria*) and articular capsule; covered by *fascia cruralis* and *Vasa cruralia*. Or.: *Crista pubis* (and a portion of the fascia below *lig. Gimbernati*). Ins.: *linea aspera* (two inches below *trochanter minor*).

[Nerve: *Cruralis*. TRANS.]

358. 9. *Adductor longus* (*superficialis II., Caput longum tricipitis*).

Pos.: covered externally by the last muscle, above by the skin, below by *Sartorius*, before *adductor brevis* and *magnus*; separated from *Sartorius* by *art.* and *ven. cruralis*. Or.: *os pubis* (between *symphysis* and *crista*). Ins.: centre of *linea aspera*.

359. 10. *Adductor brevis* (*caput breve tricipitis*).

Pos.: covered by the last muscle; at the commencement uncovered by, then behind *pectinæus*. Or.: *ram. descend. oss. pubis* (outside of *gracilis*). Ins.: *linea aspera* (superior third).

360. 11. *Adductor magnus* (*caput. magnum tricipitis*),
great adductor.

Pos.: behind the two muscles last described (forms almost alone the thick flesh on the inner part of the thigh), before *semi-tend., biceps, semimembran., glutæus maximus*. On the internal border above, *gracilis*; below, *Sartorius*. At the superior border internally, *obturator extern.*; externally, *quadrat. fem.* At the inferior extremity perforated by *art.* and *ven. cruralis*. Or.: from *tuber ischii* to *symphysis pubis*. Ins.: the whole *labium extern. lin. asperæ* to *condylus internus femor.* Use: eighth to eleventh draw the thigh inwards (especially in riding on horseback); eighth to tenth also flex it a little.

Nerve: *Obturator*.

361. *Fasciæ femoris s. lata,*

arises from the whole circumference of the outer surface of the *Ilium*, envelopes the *Glutæus maximus* (*fascia glutæa*), the anterior and posterior surfaces of the thigh; consists on the anterior surface, of very dense fibres descending from *spina anter.*

super. (that is, proper *fascia lata*), divides, at the internal border of *gracilis*, into a superficial and deep layer, and unites with fibres which are attached to *os femoris*. These are, a. the superior layer between *m. rectus* and *tensor fasciæ*; it passes from the anterior border of *os Ilei*, anteriorly above the hip-joint and neck of the *femur* like a ligament, and continues with *fascia lata* below the *trochanter major*. b. The external intermuscular ligament on the *linea aspera*, from *trochanter major* downwards to *condylus externus*, separates the flexor from the extensor muscles on the outer side. c. The internal reaches from *trochanter minor* as far as *condylus intern. femoris*, is not so strongly marked, separates *vastus internus* from *adductores*.

362. Separate sheaths: 1. for the femoral vessels, *vagina vasor. crur.*, a three-sided sheath, between the anterior and internal muscular sheaths; they help to form the femoral canal.

363. 2. The three great muscular sheaths:

a. The posterior, common to *m. biceps*, *semi tendinosus* and *semi-membranosus*.

b. The anterior divides into the following sheaths: 1. For *Sartorius*. 2. For *rectus femoris*. 3. For *vast. extern.* and *intern.* 4. For *tensor fasciæ*.

c. The internal divides: 1. For *gracilis*. 2. For *pectinæus* and *adductor longus*. 3. For *adductor brevis* and *obturator externus*.

364. 3. The femoral ring, *annulus cruralis*, this is, the three-sided opening, an inch and a half broad, through which the crural vessels pass out, behind *ligam. Poupartii*, from the abdominal cavity upon the anterior surface of the thigh. Directed obliquely from above downwards and from behind forwards, it is bounded before, by the femoral arch (which supports the *spermatic cord*, or *round ligament*), behind, by the *horizontal ramus* of the *pubes* (with *m. pectin.* and the *deep layer* of *fascia lata*), externally, by the sheath of *m. psoas* and *iliacus*; here the *vasa epigastrica* ascend. Its posterior angle corresponds to *eminent. ileo-pectinæa*; between *flexor femor.* and *pectineus*. Its external angle arises from the junction of the *lig. Poupartii* with the sheath of the *Psoas*, in which lies *nerv. cruralis*. The *lig. Gimbernati* forms the internal; it is obtuse, in the normal course of the *art. obturator* free from vessels, but between *V. cruralis* and *lig. Gimbernati* a large, deep inguinal gland lies. (*Hernia cruralis* passes out at this point.) Towards the abdominal cavity the crural ring is covered by loose uniting tissue (*septum crurale*).

365. 4. Femoral canal, *canalis cruralis*, is the excavated

space, which reaches from the femoral ring as far as to the spot where the anterior layer of the three-sided sheath of the *Vasa cruralia* commences; it consists of a three-sided fossa (*fossa ileo-pectinea*), between *m. pectineus* (internally) and *psaos* (externally), which by an incomplete anterior wall, the tendinous *proc. falciformis*, is formed into a canal. It goes downwards and inwards, is on the outer side an inch and a half, on the inner half an inch long. The superior border of *proc. falciform.* attaches itself to *lig. Poupartii*, and reaches as far as *lig. Gimbernati*; here, at the free, crescentic, internal border of *proc. falciform.* is a large anterior interval, oval fossa (*fossa ovalis*), through which *V. saphena interna* (and the place at which the *hernia cruralis* generally) passes; it is covered by the superficial layer of *fasc. superfic.* (here *lamina cribrosa*, on account of the numerous openings for vessels, nerves, and lymphatic glands), superficial inguinal glands, and skin. The femoral canal terminates below in a small opening, at the entrance to the sheath of the *vasa cruralia*.

C. Muscles of the Leg.

a. On the anterior surface.

366.

1. *Tibialis anticus* s. *hippicus*.

Pos.: beneath the skin, along the outer surface of the tibia; close to it on the outer side: *extens. digitor. ped. commun.* and (below) *propr. hallucis* (separated from *Vasa* and *Nn. tibiales antici*). Or.: the two upper-thirds of the outer surface of the tibia; the *ligam. interosseum*. Ins.: *Os cuneiforme I.* and *basis oss. I. metatarsi* (internal surface); projecting strongly. The tendon passes over the inferior extremity of the tibia towards the inner side of the foot. Use: flexes the foot, that is to say, approximates the back of the foot to the leg, and rather raises the inner border of the foot.

367.

2. *Extensor hallucis longus*.

Pos.: between 1. and 2.; external to *tibial. antic.*, separated from it behind by *Vasa* and *N. tibial ant.*; on the outer side of its tendon: *art. pedisæa*. Or.: internal to and behind the last muscle, from the centre of the inner surface of the fibula and from *lig. interosseum*. Ins.: *Basis Phalangis II. hallucis*. The tendon passes at a right angle over the dorsum of the foot upon the first metatarsal bone. Use: extends both phalanges of the great toe, flexes and raises the inner border of the foot a little.

368.

3. *Extensor digitorum communis longus*.

Pos.: beneath the skin, between *tibial ant.* and *extens. halluc.*

long. (internally), and *peronæus long.*, and *brevis* (without), covers the *fibula*, *lig. inteross.*, *artic. tibio-tarsalis*, *m. pedis*, and the toes. Or.: *condylus externus tibiæ*: inner surface of fibula, (four-fifths;) *lig. interosseum*. Ins.: *Phalanx II.* and *III.* of the second to the fifth toe. Each of the four tendons is fissured into three portions, the two lateral of which go to the third phalanx, the central to the *basis* of the second phalanx. Use: extends the third phalanx of the second, third, fourth, and fifth toes.

369. 3. *Peronæus anticus s. tertius*.

Pos.: on the outer side of the anterior surface of the leg (inferior third); between 3. and *peronæus brevis*. Or.: inferior half of *fibula* (anterior internal surface). Ins.: *Basis oss. V. metatarsi*. The tendon passes obliquely outwards under *lig. cruciat.*, over the back of the foot. Use: to flex the foot, and raise it rather outwards.

Nerves for 1. to 4.: *peroneus profundus* [*tibialis ant.*].

b. On the outer surface.

370. 5. *Peronæus longus* (s. *primus*).

Pos.: under the skin of the peronæal region, along the *fibula*; in front, separated by a fascia from *extens. digitor. longus*, behind and above from *soleus*, below from *flex. halluc. long.*; covers *peronæus brevis* externally. In the foot the tendon lies between skin and *os calcanei*, in the sole it is covered by the soft parts. Or.: *capitulum* and superior third of external surface of *fibula* (by two heads); the inferior as low as the inferior fourth. Ins.: *Basis oss. I. metatarsi*. Its tendon passes round the *external malleolus*, in a groove (also with the following muscle), curves forwards and downwards to the outer border of *calcaneus*, and passes once again curved in the groove of the *os cuboid*, obliquely forwards and inwards into the sole of the foot, to the *first cuneiform* and *first bone of metatarsus*. Use: extends the foot and draws the external border outwards and upwards. (In fractures of the *fibula* the *talus* therefore passes inwards—the outer malleolus more prominently outwards—dislocation inwards.)

371. 6. *Peronæus brevis* (s. *secundus*).

Pos.: under the last muscle, covers *fibula* above, on the anterior, below, on the posterior angle, in the centre upon the outer surface. Before it *peron. 3.*, behind it *peron. long.* and *flexor. hallucis long.* Or.: external surface of the *fibula* (inferior third). Ins.: the tendon passes forwards in the groove of the *external malleolus* upon the *calcaneus*, over *tendo. peron. longi* and *os*

cuboid. to the dorsal surface and *tubercul. metatarsi* 5. Use: extends and draws the foot outwards; abducts somewhat the little toe.

Nerves for 5. to 6.: *peronæus*.

C. On the posterior surface.

a. Superficial layer.

372. 7. *Gastrocnemius* s. *gemelli* *suræ*.

Pos.: above, by its two heads, it bounds the *popliteal* region, forms the posterior thick flesh of the calf, close under the skin; the external head covered by *biceps*, the internal by *semitendinos*. Or.: 1. The external head from *condylus femor. extern.* (*gemell. extern.*) 2. The internal head from *condylus intern.* (*gemellus intern.* stronger.) Both heads unite in the form of the letter V. Ins.: *tendo Achillis* (to *tuber calcanei*). Use: to extend the foot, rather flexing the leg.

373. 8. *Plantaris* (in man rudimentary, often wanting).

Pos.: above and to the inner side of the external head of the last muscle passing between *soleus* and *gemell. intern.* Its long tendon first between *Gastroc.* and *Soleus* lies on the inner side of *tendo Achillis*. Or.: *condylus externus femoris* (from capsular ligament), connected with *gemell. extern.* Ins.: *tuber calcanei* (before or close to the *tend. Achill.*).

374. 9. *Soleus*.

Pos.: covered, particularly, by *gemell. intern.* behind; before by *flex. digit commun.* and *hallucis propr.*, *tibial postic.*, *Vasa* and *Nn. tibial. postic.* and *fibulares*. Or.: 1. *tibiæ lin. obliq. poster.* (under *poplitæus*). 2. *Capitul. fibulæ* (posterior surface). Ins.: *tendo Achillis*. This arises from the junction of the tendons of 7., 8., and 9.; is one and a half to two inches long, is fixed broad to the posterior surface of *tuberc. calcanei*, and lies in a double sheath; the external is thick and red, the internal, thin, colourless, and more tense. Use: 7. to 9. extend the foot; 8. extends, in the lower animals, the *fascia plantaris*.

b. Deep layer.

375. 10. *Poplitæus*.

Pos.: small, thin, triangular, oblique from without, downwards and inwards upon the knee joint, covered by *plantaris* and *gastrocnemius*, separated by *Vasa poplit.* and *n. poplit. intern*. Or.: fossa behind [at the side of] *condyl. extern. femoris* (under *m. gemellus. extern.*). Ins.: the triangular, posterior (and supe-

rior) surface of *tibia*. Use: to flex the leg and roll it somewhat inwards.

376. 11. *Tibialis posticus s. nauticus*.

Pos.: the deepest, between *tibia* and *fibula* upon *lig. interosseum*, covered by *flexor commun. long.*, *halluc. propr.* and *soleus*. Its tendon in front of that of the *flex. comm. longus*, goes under the internal malleolus. Or.: *tibia* (posterior surface), *fibula* (internal angle), *lig. interosseum*. Ins.: *tuber oss. navicularis* (inner border); and with aponeurotic appendages to *oss. cuneiform. 2. and 3.* Use: extends the foot, rotates the sole inwards.

377. 12. *Flexor digitorum communis long. s. perforans*.

Pos.: the most internal, along the posterior surface of the *tibia* and sole of the foot, penniform; between *tibial. post.* and *tibia*, covered above by *soleus*, behind *Vasa* and *Nn. tibiales postici*. Or.: *linea obliq. tibiæ* (under *m. poplit.* and *soleus*), and three-fifths of the centre of the *Tibia* (posterior surface). Ins.: *Basis phalang. III.* of the second to the fifth toe (plantar surface). The tendon lies: on the *internal malleolus* behind that of the *tibial post.*, on the inner border of the foot rather externally; passes between *calcis* and *abductor. halluc. long.* into the sole of the foot; in the *metatarsus* upon the *interossei*. Use: flexes the four outer toes, and after that extends the foot.

REMARK. Pulleys and tendinous sheaths like the flexors of the fingers.

378. 13. *Flexor hallucis longus*.

Pos.: the most external and strongest, covered behind by *soleus* and *tendo Ach.* behind *fibula*, *tibial. post.* and *Art. peronæa*, (below) *lig. inteross.* On the outer border: *peron. long.* and *brev.*; on its inner border: *flex. communis long.* The tendon curves towards the sole, passing obliquely over the *flex. commun. long.* Or.: *fibula* (posterior internal surface from the two inferior thirds). Ins.: *Basis phalang. II. hallucis* (plantar surface) united (by *fascia*) with the last muscle. Use: to flex the second phalanx of the great toe; assists (when the foot is raised) to extend the foot.

[In the sole of the foot the tendon of this muscle is connected, by a tendinous slip, with that of the last.]

Nerves for 7. to 13.: *tibialis*.

379. *Fascia s. vagina cruris*.

Invests only those parts of the leg covered by muscles, is connected above and behind with the *fascia femoris*, strengthened by tendinous expansions from the *biceps*, *sartorius*, *gracilis*,

semitendinosus; above and before, in front of the *Patella*, likewise with the *fasc. femoris*, below with the ligaments of the bend of the ankle. Its external, cutaneous surface forms a sheath for *vena* and *nerv. saphæn. extern.*; the internal attaches itself to the *crista tibiæ* and *fibulæ*, and forms three principal sheaths for the anterior, external and posterior muscles, and several secondary sheaths (e. g., between the superficial and deep layer on the posterior surface). On the *malleoli* it forms the following ligaments:

380. 1. *Lig. transversum*, an inch and a half broad, passes from the anterior angle of the *tibia* to that of the *fibula*, and covers the inferior portion of the muscles.

381. 2. *Lig. cruciatum tarsi*, consists of striæ one half to one inch broad, crossing over the tarsal joint. a. The superior passes from the *internal malleolus* to the superior and outer surfaces of *proc. anter. calcanei*, develops two tendinous sheaths, an internal (for *tibial. antic.*), an external (for *extens. digit. comm. long.* and *peron.*), and a central, incomplete, for *extens. halluc. long.* and *Vasa* and *Nn. tibiales antici.*) Retzius describes underneath a sling-shaped ligament, *lig. fundiforme tarsi*, which lies in a crescentic form over the tendon of *extens. commun. long.* and *peronæus tertius*. b. The inferior, from the *external malleolus* to the internal border of the foot, continues into the *aponeurosis plantar. (interna)*, and forms, likewise, upon the back of the foot, sheaths for the before-described muscles.

382. 3. *Lig. laciniatum tarsi intern.*, from the inner *malleolus* to the inner side of *Calcaneus*, forms four sheaths: a. for *art., ven.,* and *n. tibial. post.* (the most superficial); b. for *m. tibial postic.* (the anterior); c. *m. flex. digit. comm. long.* (the posterior). Both behind the *malleolus intern.*; d. for *m. flex. hallucis long.* (the most inferior).

383. 4. *Lig. laciniatum tarsi externum*, from the *external malleolus* to the *calcaneus*, forms at the commencement a common sheath, afterwards divided into two, for *m. peronæus longus* and *brevis*.

D. Muscles on the Foot.

a. Upon the dorsum of the foot.

384. 1. *Extensor digitorum brevis* s. *pediæus*.

Pos.: oblique from without, inwards, and from behind, forwards, under the tendons of the long extensor of the toes, over the anterior row of the tarsal and metatarsal bones. On the inner border: *Art. pediæa*. [*extens. hallucis brevis* is the strongest]. Or.: *Proc. anterior calcanei* (external surface). Ins.: *Phalanx I.* of the first to the fourth toe, on the external border of the long

extensor of the toes and the *extens. hallucis*. Use: extends the first phalanx of the four inner toes.

Nerves: *peronæus profundus* [*tibial. ant.*].

b. On the internal region of the sole of the foot.

a. Attached to the inner surface of the first phalanx of the great toe.

385.

2. *Abductor hallucis*.

Pos.: on the internal border of the foot, beneath the skin, under the flexor muscles of the great toe, on the outer border of *flex. halluc.* and *communis brevis*. Or.: 1. The long (posterior) head from the posterior and inner surface of the *tuber calcanei*. 2. The short head from *os cuneiforme I.* and *fasc. plantaris*. Ins.: *Os sesamoideum* on the basis of first phalanx of great toe. Use: to draw the great toe from the second, and flex it.

386.

3. *Flexor hallucis brevis*.

Pos.: on the first *os metatarsi*, between *abductor* and *adductor*. Or.: *Os cuboideum* and *os cuneiforme III.* Ins.: *Os sesamoideum internum*. Use: flexes the first phalanx of great toe.

β. Attached to the external surface of the first phalanx of the great toe.

387.

Adductor hallucis.

Pos.: strong, triangular, in the concavity between the second and fifth *os metatarsi*, above *flexor longus, lumbricales*, under *interossei* and *Art. plantar. externa*; on its inner border: *tendo peronæi longi* and *flex. halluc. brevis*. Or.: 1. *Os cuboideum* with *flex. hallucis brevis*. 2. *Tendo peronæi longi*, oblique to the insertion: into *Os sesamoideum externum*. Use: draws the great toe outwards towards the centre of the foot, and flexes it.

388. 5. *Transversalis pedis* (s. *adductor transversus*).

Pos.: small, and transverse between *os metatars. IV.* and *hallux* in the anterior part of the concavity of the *metatarsus*, above *lumbricales*, under *interossei*; is the anterior short head of the last muscle. Or.: *Capitul. oss. metat. IV.* and *V.* Ins.: *Os sesamoideum externum*. Use: approximates the great to the little toe, making the sole hollow (like *mm. opposites* of hand).

c. On the outer region of the sole of the foot.

389.

6. *Abductor digiti minimi*.

Pos.: close above *fasc. plantar. extern.*, under the following muscle; on the outer edge of the foot. Or.: *tuber. extern. calcanei* and *aponeur. plantar. ext.* Ins.: *Basis phalang. I.* of the

fifth toe (outer side). Use: draws the fifth toe from the fourth, and rather flexes it.

390. 7. *Flexor brevis digiti minimi* (s. *interosseus V.*).

Pos.: on the outer border of *os metatars. V.*, above the tendon of the last. Or.: 1. *Lig. calcaneo-cuboid.* 2. *Basis oss. metatars. V.* Ins.: *Basis Phalang. I.* of fifth toe (plantar surface). Use: draws the outer border of the foot downwards and inwards; rather flexes the first phalanx of the fifth toe.

d. In the centre of the sole of the foot.

391. 8. *Flexor digitorum brevis s. perforatus.*

Pos.: close above *fascia plantar.*, under *Vasa* and *Nn. plantar.*, *tendo flex. long.*, *muscul. accessor.*, *lumbrical.* Or.: from *tuber intern. calcanei*, and *fasc. plantar.* (centre). Ins.: each of the four tendons (perforated by *flexor long.*) passes divided to the borders of the second phalanx of the second to the fifth toe. Use: to flex the second phalanx of the second, third, fourth, and fifth toes.

392. 9. *Quadratus plantæ s. Caro quadrata Sylvii s. musculus accessorius.*

Pos.: above the last muscle, the vessels and nerves of the sole of the foot; under *Calcaneus* and *lig. calcaneo-cuboid. infer.* Or.: 1. Groove upon the under surface of *Calcaneus.* 2. *Lig. calcaneo-cuboideum.* Ins.: the external border and the inferior surface of the tendon of *m. flexor. comm. longus.* Use: assists in flexion, and draws the tendons of *flexor longus* outwards.

393. 10. *Lumbricales IV.*

Pos.: on the inner border of the tendons of *flexor digitor. longus.* Or.: the angle of division of the tendons of *flexor digit. long.* (inner edge). Ins.: *Basis phalang. I.* of second to the fifth toe. Use: to flex the first phalanx of the second, third, fourth, and fifth toes.

394. 11. *Interossei interni plantares, 4.*

Pos.: between the metatarsal bones of the first to the fifth toe; covered by the following muscles. Or.: the internal (tibial) side of the second to the fifth *os metatars.* Ins.: first phalanx of the second to the fifth toe (tibial side). Use: to draw the four outer toes inwards towards the first.

395. 12. *Interossei externi s. dorsales, 3.*

Pos.: between the metatarsal bones of the second to the fifth toe; perforated at the posterior extremity by *Artt. perforantes.*

Or.: by two heads from the surfaces of two metatarsal bones as they are turned to one another. Ins.: the *fibula* (external) border of the second to the fourth toe. Use: to draw the four outer toes from the great toe.

Nerves for 2. to 12.: *plantaris extern. et internus*.

396. *Fasciæ musculares pedis*.—a. *fasc. dorsalis*, a thin membrane which, commencing behind from the *fascia cruris*, covers the back of the foot, in front on the *first phalanx* of the toes passing over into the sheaths of these, and at the sides into the *fascia plantaris*; a superficial layer covers the tendons of *extens. digit. longus*; a central the *extens. digit. brevis* (before); a deep the *interossei*.—b. *Aponeurosis plantaris*, a thick, shining membrane, which commences behind on the *tuber Calcanei*, at first narrow, then broader, terminating in the region of the anterior extremities of the metatarsal bones in four lappets, *laciniæ plantares*, which are divided, and form four sheaths for the tendons of the flexor muscles of the second and four outer toes. These sheaths are separated by three arches, under which the *mm. lumbricales* and *interossei* and the plantar vessels and nerves pass away. The borders curve round from above and below, surround the *flexor digitor. brevis*, and form septa between the muscles of the centre and the outer and inner region of the sole of the foot. Externally an *apon. plantaris externa* (attachment of *M. abduct. digiti minimi*) passes off, which is attached in front to the *basis oss. metatarsi V.*, and forms a sheath for *abductor* and *flexor brevis digiti V.* Internally a thinner, *f. plantar. intern.*, which commences behind between *Malleolus intern.* and *Calcaneus*, is attached to the inner border of the *Tarsus*, and forms a tendinous sheath for *flexor* and *abductor brevis hallucis*, and *art. and ven. plantar. intern.* The central sheath encloses: *M. flexor digitor. brevis*, *tendo m. flexor digitor.* and *hallucis longus*, *Caro quadrata Sylvii*, *lumbricales*, *adductor halluc.* and *transversal. pedis*, *Vasa* and *nerv. plantares externi*. *Mm. interossei* lie in separate sheaths.

c. The ligaments and sheaths of the toes are analogous to those of the fingers.

Summary of the Actions of the Muscles.

I. Head.

397. A. The whole head, the neck being fixed, moves:

a. Forwards (flexion): *Sterno-cleido-mast.*, *rectus capitis anticus* of both sides.

b. Backwards (extension): *cucullaris*, *splenius capit.*, *biventer*

and *complexus cervicis*, *trachelo-mastoid.*, *rectus postic.* and *obliq. sup.* of both sides.

c. Sideways: *sterno-cleido-mast.*, *rectus capit. lateralis*, *splenius capit.*, *trachelo-mast.*, *obliq. capitis super.* of one side.

d. The head rotates sideways at the same time with the Atlas: *splenius capitis*, *trachelo-mast.*, *obliq. cap. infer.* of the one and *sterno-cleido-mast.* of the other side.

398. B. The skin moves upon the skull:

a. Forwards: *frontales*, which at the same time put the skin of the forehead into transverse wrinkles.

b. Backwards: *occipitales*, which at the same time make the skin of the forehead smooth.

399. C. The ear is drawn:

a. Upwards: *attollens*; forwards: *attrahens*; backwards: *retrahentes*.

400. D. The eye:

a. The eyebrow is drawn inwards and downwards with longitudinal wrinkles: *corrugator superc.*

b. The fissure between the lids contracted and closed by: *sphincter palpebr.*

c. The upper lid raised: *levator palpebr. super.*, by which the skin passes backwards.

d. The globe of the eye is directed outwards, inwards, upwards, downwards: *recti*.

e. The same is rotated upwards and inwards: *obliq. super.*; downwards and outwards: *obliq. infer.*; upwards and outwards: *obliq. infer.* and *rect. extern.* together.

401. E. The nose:

a. Is drawn down and the nasal openings contracted by: *depressor alæ* and *compressor*.

b. Drawn outwards and widened by: *dilatator posterior* and *anterior*.

c. Turned up by: *levator alæ et labii* (*s. pyramidalis*).

402. F. The mouth:

a. The fissure of the mouth is shortened and closed: by *sphincter oris*.

b. The angle of the mouth is drawn downwards and backwards, by which the cheeks are pressed against the rows of teeth (as in mastication) and the cheeks are expanded (as in blowing and whistling): *buccinator*.

Upwards by: *lev. anguli oris* and *zygomat. major*.

Downwards (it is pretended) by: *triangular. with transv. menti.*

c. The upper lip is raised by: *levator labii, alæ nasi et labii super., zygomatic. minor.*

d. The under lip drawn downwards and everted by: *quadratus menti.* It is raised, when the skin of the chin is stretched, by: *levator menti.*

403. G. The lower jaw is:

a. Drawn downwards by: *digastric. maxill., mylo-, genio-hyoidei.*

b. Drawn upwards by: *masseter, temporalis, pterygoideus internus.*

c. Pushed forwards and to the opposite side by: *pterygoideus externus.*

404. H. The soft palate is:

a. Raised and stretched transversely by: *levator palati mollis;*

b. Depressed (thereby elongated and stretched) by: *pharyngo-palatin., glosso-palatinus.*

c. Shortened (the uvula thereby elevated and curved backwards) by: *azygos [levatores] uvulæ.*

d. Stretched (it is pretended) by: *circumflex. palati mollis.*

405. I. The Pharynx is:

a. Contracted by: *three constrictores pharyngis.*

b. Raised and widened by: *stylo-pharyng., salpingo-pharyngeus.*

406. K. The os hyoides is:

a. Raised forwards by: *digastricus* (anterior belly), *mylo-hyoideus, genio-hyoideus.*

b. Backwards by: *stylo-hyoid., digastricus* (posterior belly).

c. Drawn downwards by: *omo-, sterno-hyoideus, hyo-thyreoides.*

407. L. The tongue is:

a. Compressed against the floor of the mouth by: *genio-, hyo-glossi.*

b. Base and borders raised backwards by: *stylo-glossi.*

c. Shortened, and the apex curved upwards and backwards, by: *lingualis superfic.;* shortened, and the apex curved downwards, by: *lingual inferior;* diminished, elongated, and rounded at the apex, by: *lingual transversus.*

408. M. The larynx is:

a. Drawn downwards (*trachæa* shortened) by: *sterno-thyreoides.*

b. Drawn upwards, towards the *os hyoides* (*Epiglottis* curved backwards), by: *hyo-thyreoid*.

c. The epiglottis bent back (and the entrance shut) by: *reflector epiglottidis*.

d. The vocal cords removed from one another, and the entrance widened by: *crico-arytænoideus posticus*.

II. Trunk.

409. A. The neck is:

a. Flexed by: *longus colli* and *scaleni* (3) of both sides.

b. Extended by: *splenius colli*, *transversal*. (and *spinales*, *semi*-, *inter-spinales*, *multifidi*).

c. Drawn sideways by: *transversal*., *cervical. descend.*, *spinalis* and *semispinalis cervicis*, *obliq. capit. infer.* (on the *atlas*), *intertransv.* and *multifid.*, *scalenus med.* and *post.* of one side. Rotated by: *splen. colli.*, *transversal.*, *cervicalis* of the other. The skin of the neck is moved by: *platysmamyoides*.

410. B. Thorax. 1. The thoracic portion of the vertebral column is:

a. Flexed by: *recti*, *obliq.* and *pyramidales abdominis*.

b. Extended by: *multifidi*, *interspinales*, *spinales* and *semi-spinal. dorsi*, *sacro-lumbales* and *longissim. dorsi*.

c. Drawn sideways by: *multifidus* on one side; rotated by: *rotatores dorsi* and *multifidus* of one side.

411. 2. The ribs are:

a. Elevated and the chest widened as the lungs expand, and the diaphragm contracts downwards (descends) by: *intercostales*, *levator costarum*, *scaleni* (they fix the first ribs), *serratus posticus superior*. As in inspiration.

NOTE. Deep inspiration is effected by *sterno-cleidomast.*, *subclavius*, *pectorales*, *serratus anticus*, *latissim. dorsi*, *cervicalis descend.* The *intercostales* (and *infra-costales*) approximate the ribs, since they draw them upwards (inspiration) or downwards (expiration).

b. Drawn downwards by: *intercostales*, *serratus post. inferior*, *triangularis sterni*, *quadratus lumborum* (fixes the twelfth rib), abdominal muscles. As in expiration.

412. 3. The sternum is:

a. Drawn up by: *sterno-cleido-mast.*, *sterno-hyoidd.*

b. Downwards by: *recti abdominis*.

413. C. The lumbar portion of the vertebral column is:

a. Flexed by: *psaos major et minor* of both sides.

b. Extended by: *longissim. dorsi*, *ileolumbalis*.

c. Inclined sideways by: *quadrat. lumbor.*, *multifidus* and *inter-transversarii* of one side.

414. D. The coccyx is:

a. Flexed by: *sacro-coccygeus anticus*, *coccygeus*; *levator ani*.

b. Extended by: *sacro-coccygeus posticus*.

415. E. The pelvis is drawn and rotated forwards, backwards, and sideways by the flexors, extensors, and rotators of the thigh.

a. The anus is closed by: *Sphincter ani*; *anus* and *prostate* elevated by: *levator ani*.

b. The urethra is compressed by: *constrict. isthmi urethr.*; the *corp. cavernosa* by: *erector penis*; the bulb by: *bulbo-cavernosus*.

c. The bladder is drawn down by: the *vesicalis*; the vagina contracted by: *constrictor vaginæ*.

d. The testes raised towards the external abdominal ring by: *cremaster*.

III. Superior Extremity.

416. A. The clavicle is:

a. Raised by: *cucullaris*, *cleido-mastoideus*.

b. Drawn down by: *subclavius*, *pectoral. major*, *deltoideus*.

417. B. The scapula is drawn:

a. Upwards by: *lev. anguli scap.*, and *cucullaris*.

b. Forwards, inwards, and downwards by: *pectoral. minor*, *coraco-brachialis*.

c. Forwards and outwards by: *serratus ant. major*.

d. Backwards by: *rhomboidei*, *cucullaris*.

[The shoulder is rotated by: *serratus ant. major*.

418. C. The humerus is:

a. Abducted by: *deltoideus*, *coraco-brachial*, *supra-spinalus*.

b. Adducted by: *pectoral. major.*, *latissim. dorsi*, *teres major*.

c. Rotated outwards by: *infra-* and *supra-spinatus*, *teres minor*; inwards by: *subscapularis* and *teres major*.

419. D. The fore-arm is:

a. Flexed by: *biceps* and *brachialis internus*.

b. Extended by: *triceps* and *anconæus*.

c. Proned by: *pronator teres* and *quadratus*.

d. Supined by: *supinator longus* and *brevis*.

420. E. The hand is:

a. Flexed by: *flexor carpi radial.* and *ulnaris*, *palmaris longus*.

b. Extended by ; *extensores carpi radiales* and *ulnaris*.

c. Adducted, that is, moved towards the *ulnar* border of the arm by : *flex.* and *extens. carpi ulnaris* ; abducted (towards the *radial* border) by : *extens.* and *flexor radiales carpi* ; Proned and supined, see D.

421. F. The fingers are :

a. Flexed by : *flexor digitor. (sublimis* second phalanx of the second, third fourth, and fifth fingers) ; by *flexor digitor. profundus* (third phalanx of the same fingers ; by *lumbricales* (first phalanx of the same fingers) ; first phalanx of thumb, by *flexor pollicis brevis*, second phalanx by *fl. poll. longus* ; of little finger, by *fl. digiti minimi*.

b. Extended by : *extens. comm.* (second, third, fourth, and fifth fingers) ; the thumb by : *extens. pollic. long., brevis* and *abductor longus* ; the index finger by : *extens. indicis* ; the fifth finger by : *extens. dig. minimi propr.*

c. Adducted (towards the middle finger) by : *interossei* and *adduct. pollicis*.

d. Abducted by : *interossei, abduct. pollic.* and *digiti minimi*.

e. The thumb and little finger approximated by : *opponens pollic.* and *digit. min.*, whereby the hand is made hollow.

422. IV. Inferior Extremity.

A. The thigh is :

a. Flexed by : *psaos* and *iliacus* [and *pectineus*].

b. Extended and abducted by : *glutæi* (3).

c. Adducted by : *adductores* (3) and *pectinæus*.

d. Rotated outwards by : *pyriformis, gemelli, obturatores, quadratus femoris*.

e. Rotated inwards by : *tensor. fasciæ lat.*, and the anterior part of *glutæus med.* and *minimus*.

423. B. The leg is :

a. Flexed by : *biceps, semitendinosus, semimembranosus, poplitæus, sartorius gracilis*.

b. Extended by : *vastus externus* and *internus, cruralis* and *rectus femoris*. These muscles assist at the same time to flex the pelvis upon the thighs.

c. Rotated, outwards, by : *biceps* ; inwards, by : *sartorius, gracilis, semitendinosus, poplitæus*.

424. C. The foot is :

a. Extended by : *gastrocnemius, solæus, plantaris longus ; tibialis posticus* and *peronei long. and brevis* ; assisted by the *flexors* of the toes.

- b. Flexed by: *tibialis anticus* and *peronæus tertius*; assisted by the *extensors* of the toes.
- c. Adducted by: *tibialis anticus* and *posticus*.
- d. Abducted by: *peronæi* (3). Neither *pronators* nor *supinators* are found on these bones.

425. D. The toes are:

- a. Extended by: *extens. digitor. comm. long.* and *brevis* (second, third, fourth, and fifth toes), *extens. halluc. longus*.
- b. Flexed by: *lumbricales* (first phalanx); *flex. comm. brevis* (second phal.), *comm. long.* (third phal.) and *caro quadrata*; the great toe by *flex. halluc. prop. long.* (second phal.), *brevis* (first phal.).
- c. Adducted by: *interossei interni*, *adduct. hallucis*.
- d. Abducted by: *interossei externi*, *abduct. hallucis* and *digiti minimi*.

SPLANCHNOLOGIA.

OF THE VISCERA.

"The best means of avoiding the errors which have now been referred to, (viz., the construction of hypothetical theories, or the assumption of principles which are altogether gratuitous and imaginary, and the deduction of general principles or conclusions from a limited number of facts,) will probably be, to keep in mind the important principle, that the object of physical science is, 'to ascertain the universality of a fact.' A considerable number of medical doctrines, there is reason to apprehend, will come out of the examination in rather an unsatisfactory manner, if we apply to them the tests which this rule would furnish, namely—are they facts, and are these facts universal?"—**ABERCROMBIE.** *Path. and Pract. Researches on the Diseases of the Stomach, &c., Preface.*

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426. THE VISCERA, σπλάγχνα,

are very compound organs, consisting of various tissues, several of which together form a system destined to the performance of some particular function. Belonging to this division we have the Organs of Digestion, Respiration, Generation, Micturition, and the Senses.

427. A. Organs of Digestion, *Organa digestionis*,

consist of one canal, which extends from the opening of the mouth to that of the anus, and several appendages (as: oral and salivary glands, liver, ventral salivary glands, spleen).

a. Parts *above* the Diaphragm.

428. 1. Cavity of the Mouth, together with its appendages.

Cavum oris, mouth, is situated at the inferior part of the face between the two jaws and the cheeks, behind the lips and before the pharynx. Its roof forms in front the hard palate, behind the soft; its floor the tongue and *mm. genio-, hyo-glossi, genio- and mylo-hyodei*. Before, it opens externally between the lips; behind, through the fauces, *isthmus faucium*, into the pharynx. The anterior, or buccal cavity, is the space between the cheeks and the dental alveoli; the proper mouth, the space between the dental alveoli and the fauces.

The Lips, *labia*, form the moveable anterior wall of the cavity of the mouth, separated by the transverse oral fissure, *os*, into the upper and under lips, placed (in man) vertically over one another, before the alveoli and the teeth. Their thick, everted, red edges, *prolabia*, are bounded laterally by the angle of the mouth, *angulus oris*. On the anterior surface covered by the external skin, the upper lip is bounded by the skin of the cheek at the projecting internal border of *m. levator labii super. aequae nasi*, the under lip at the inner border of *m. triangularis*. The *linea naso-labialis* (s. *abdominalis*) thence arising (the strongly-marked furrow of intestinal disorder), commences at the *ala* of the nose, and terminates at the sides of the chin. On the upper lip we observe: the mustachios, *mystax*; in the centre a longitudinal furrow, *philtrum*; on the under lip: the beard, *pappus*; upon the transverse groove or the boundary between the under lip and chin, *sulcus mento-labialis*.—The posterior (internal) surface of the lips is covered with mucous membrane, which applied to the gums, is beset with glands, *glandulae salivales labiales*, and in the centre, particularly of the upper lip, forms a fold, *frenulum*. Between the external skin and the mucous membrane is placed the proper foundation of the lips, namely, *m. orbicularis oris* (see before), together with fibres from the muscles bordering it.

Vessels of the lips.—Arteries: 1. *Artt. coronariae* from *art. facialis*. 2. *Artt. buccales, infraorbitales, alveolares* for the upper lip,—from *Art. maxillar. interna*, —*mentales* for the under lip from *art. facialis*. Veins: *plexus labialis*, opens

into *Ven. facialis anterior*.—Lymphatics: open into the glands at the base of the chin.

Nerves: first division of fifth and seventh cerebral nerves, from *plexus infraorbitalis* and *mentalis*.

Uses of the lips: Sucking, Speech, &c., expression of the affections. The under lip more especially prevents the efflux of saliva.

Cheeks, *buccæ*, *genæ*, bounded above, by the *Basis orbitæ*, below, by the basis and externally by the posterior border of the lower jaw, consist of the following parts:—

Skin, very vascular, delicate, particularly in the region of *eminentia malaris* (malar bone), where it is firmly fixed; beset with the whiskers, *julus*. A deposit of fat, thick in the central region, between *m. masseter* and *buccinator*.

Muscles: 1. *M. masseter*, and *risorius* in the *regio masseterica*. 2. *Musc. orbicularis palpebr.* in the *regio malaris*. 3. *M. buccinator*, *zygomat. major* and *minor* in the *reg. buccalis*.

Salivary glands: *glandulæ buccales*, between the muscles and the mucous membrane opening upon the last; two larger, *gl. molares*, lie between *m. buccinator* and *masseter*, and open in the region of the last molar teeth.

The mucous membrane is perforated in the region of the first and second superior molar teeth by *ductus Stenonianus*. *Ductus Stenonianus*, accompanied by *nerv. buccal. med.*, below *art. transv. faciei*, curves inwards at the anterior border of *m. masseter*, perforates the fat which covers the *m. buccinat.* and the muscle itself at a distance of five lines from *m. masseter* and four from the inferior border of *os. zygomat.*

Vessels.—Arteries: 1. Branches of *art. maxillar. externa* and *transversa faciei*. 2. Branches of *art. maxillaris interna*, as: *infraorbitalis*, *dentalis infer.*, *buccalis*, *masseter.*, *alveolaris*. Veins: *plexus buccalis*, which opens into the *v. facialis anterior*. Lymphatics: they pass into the glands in the *parotis* and of the neck.

Nerves: 1. Branches of *N. facialis*, *buccales*, and *malares*. 2. Branches of *N. trigeminus*, *rami buccinatorius*, *massetericus*, *infraorbitalis*, *mentalis*.

Uses: Chewing, Sucking, Speech, &c.

The Palate, *palatum durum*, is formed by the *processus palatini* of the upper jaw and the horizontal of the palate bones, covered by a spongy thick membrane, perforated by vessels, nerves, and glands, *membrana pulposa palati*, which, especially anteriorly, in the rough places, is firmly connected with the periosteum. It is vaulted, presents in the middle line a suture, and at the anterior termination of this the opening of *canalis incisivus* (for *nerv. nasopalatinus*).

Salivary glands: *glandulæ palatinæ* are particularly numerous at the posterior extremity of the raphé.

Vessels. *Art. et ven.*: Branches of the *spheno-* and *pterygo-palatina*.

Nerves: *naso-palatinus* *Scarpæ* and *palatinus anterior*.

The soft palate, *palatum molle* s. *mobile*, *velum palatinum*, *velum pendulum*, *palati*, is the membrano-muscular valve which separates the oral from the nasal cavities and pharynx. It hangs downwards in a curvilinear form from the posterior border of the hard palate, in swallowing (during the passage of food) horizontal; it presents an inferior concave and a superior convex surface which elongates the floor of the nasal fossæ. From the centre of the inferior border, the *uvula* is dependent, the apex of which may sometimes rest upon the basis of the tongue, a few lines before the opening of the larynx, and sometimes it is fissured. The lateral borders of the *velum*, between the

posterior extremity of the superior and that of the inferior alveolus, correspond to the anterior border of the *m. pterygoid. internus*, consisting, to a great extent (especially behind the last inferior molar tooth), of a series of glands. From the *Uvula* two folds pass downwards on either side, the palatine arches, and form the *Isthmus faucium*.

1. *Arcus palatinus anterior* s. *glosso-palatinus*, the anterior palatine arch, arises from the base of the *uvula*, is connected at the borders of the tongue, in the region of the anterior extremities of the *papillæ calcinæ*, which are arranged in the figure of the letter V with these, and contains the *mm. glosso-palatini*.

2. *Arcus palatinus posterior* s. *pharyngo-palatinus* arises from the apex of the *uvula*, passes obliquely downwards, backwards and outwards to the sides of the pharynx, is smaller, but reaches farther inwards; it contains the *mm. pharyngo-palatini*, and is uneven in consequence of a circle of glands. Between the two arches are situated on either side in a depression, one of the

3. Tonsils, *tonsilla*, *amygdalæ*, that is, a group of mucous follicles, compound glands, which, directed obliquely downwards and forwards, is turned towards the internal (free) surface of the perforated mucous membrane, covered externally by the *fascia pharyngea* and the angle of the lower jaw. The tonsils consist chiefly of uniting tissue disposed in channels in which the numerous vessels pass, and between which the granular glandular mass is placed with many excretory ducts. Arteries come from *art. labialis, pharyng. inferior, lingual., palatina infer. and superior*. Veins: *plexus tonsillar*is from *plexus pharyngeus*. Nerves: are branches of *N. lingual.* and *glosso-pharyngeus*, on the outer border. Function: to secrete mucus which lubricates the fauces.

4. *Isthmus faucium*, the fauces, that is, the opening between the palatine arches, which may be contracted by the tonsils and by the play of the muscles.

The mucous membrane of the soft palate is covered with little glands (*gl. salivares*), at the free extremity more delicate. The numerous arteries come from *Art. palatina ascendens* and *descendens*. Veins: of the same name. Nerves: branches of *rami palatini* from *Ganglion Meckelii* and *n. glosso-pharyngeus*. (The *uvula* contains much loose uniting tissue, which is easily infiltrated with blood or serum). Muscles (see before).

Uses of the soft palate: in deglutition, speech and singing.

429. 1. The Tongue, *Lingua*, γλῶσσα,

the muscular organ for taste, is situated above, before and at the sides, free and moveable, in the cavity of the mouth, attached by ligaments to the hyoid, bone and by muscles to this, to the *Proc. styloidei* and lower jaw; before horizontal, then curved and towards the hyoid bone almost perpendicular. Here at the root, *radix* s. *basis linguæ*, it is also connected with the *epiglottis*. Its point, *apex*, is placed close behind the incisor teeth. The superior free surface, *dorsum linguæ*, divided by a groove into two lateral halves, is rough, covered with numerous mucous glands and lingual papillæ; the inferior surface is free in the anterior third only; it presents in the centre a groove, at the sides of which the *Vv. raninæ* and *Mm. linguales*, and the *frenulum*,

that is, a fold of the oral mucous membrane, which, abstractedly of the muscles, attaches the tongue to the floor of the mouth. On either side of the frenulum behind the excretory ducts of the salivary glands *bursæ mucosæ* are placed (according to Fleischmann the seat of *ranula*).

a. The substance of the tongue, *caro linguae*, consists for the most part of *m. lingualis*, which forms, on the superior and inferior surfaces, a longitudinal layer extending from the hyoid bone to the apex of the *m. stylo-glossi*, the internal fibres of which are transverse, and *mm. genio-glossi*, the fibres of which, curved above, pass vertically, and *mm. hyo-glossi*, which likewise enter the tongue vertically between *m. lingualis* and *stylo-glossi*. In the centre of the root, attached to the anterior surface of the *Basis oss. hyoidei*, a thin lamina of cartilage is found, the inferior border of which lies between *mm. genio-glossi*.

b. The lingual membrane, *involutum s. cutis linguae*, thicker than the mucous membrane of the mouth, and firmly attached to the places where it is beset with papillæ, is covered with Epithelium (*periglottis*). It forms besides the *frenulum linguae*, 3 *ligg. glosso-epiglottica*, from the root of the tongue to the Epiglottis, and several triangular folds, *fimbriæ linguae*, under the borders of the tongue.

c. *Lingual*, or gustatory papillæ, *papillæ linguae*, are small elevations upon the back and edges of the tongue, composed of condensed uniting tissue, and provided with capillary vessels and delicate nerve filaments.

1. *Papillæ vallatæ*, s. *truncatæ* s. *calicinæ*, 7—16—20, in the form of a capital V (the apex behind—the last called *foramen cæcum* s. *Meibomii*) at the root of the tongue, like an inverted cone, surrounded all round with a fossa and a wall.

2. *Pap. conicæ, filiformes*, the smallest and most numerous, lying on the apex and the anterior part of the back of the tongue, in an oblique direction from before, backwards.

3. *Pap. lenticulares s. fungiformes*, which, shaped like a club, are found dispersed between the *Pap. conicæ*. At the edges obliquely inwards towards the root of the tongue, we find four or five parallel fissures beset with nervous papillæ; these are *rugæ transversæ Arnoldi* (s. *pap. lingualis foliata*, Mayer).

Uniting and adipose tissue is dispersed particularly at the posterior part of the tongue.

Vessels: *Artt. and Ven. linguales, palatinæ and pharyngeæ inferiores*.

Nerves: 1. *Hypoglossus*. 2. *Ram. lingualis N. quinti*. 3. *Glosso-pharyngea*.

Movements: (see Muscles, before.)

430. 2. Salivary glands of the mouth, *glandulæ salivales oris*.

a. The parotid, *gl. parotis*, is larger than the other salivary glands, irregular in shape, and placed before and below the auricle of the ear.

Basis, or external surface: broad, oblong, covered by *fascia parotidea*, *m. risorius*, and skin.

Anterior surface: concave, surrounds the posterior border of *ramus maxillaris infer.*, separated from it by uniting tissue; behind *m. pterygoideus intern.*, *lig. stylo-maxillare*, *m. masseter*, from the external surface of which it is separated by *rami n. facialis*, loose uniting tissue, and *art. transversa faciei*.

Posterior surface, likewise concave, lies against the cartilage of the *external*

auditory meatus, firmly united to it, before *Proc. mastoideus*, *Mm. Sterno-cleido-mast.* and *digastric.* (post. belly.)

The internal edge is bounded by *Proc. Styloideus* and the muscles arising from it. Between this and *m. pterygoideus internus* we find a prolongation, with a groove for *Art. carotis externa*. The superior border lies under *Arcus zygomat.* and *Artic. temporo-maxillar.* The inferior extremity fills the space between *angulus maxillar. inf.* and *m. sterno-cleido-mast.* separated from the *gl. submaxillaris* by a fibrous septum.

Withinside the gland are situated, *Artt. temporalis, transv. faciei, auriculares anterr.; V. facial. posterior; N. facialis* and its *plexus anserinus; N. auricular.* from *plexus cervicalis*, but superficial; (red) lymphatic glands.

Structure. Single *acini* are united into *lobuli*, which are held together by the dense general envelope of the *gl. parotis*.

The Excretory duct, *ductus Stenonianus*, arising from the associated ducts of all the *acini*, passes out from the centre of the anterior border of the gland, crosses horizontally forwards (below *art. transv. faciei*) five or six lines under the zygoma, over the external surface, to the anterior border of the *m. masseter*, curves at this point around a mass of fat, perforates it and *m. buccinator* vertically, and passes for some lines between it and the mucous membrane, until it opens in the region of the first and second molar teeth. It is thicker at the anterior than at the posterior extremity; it consists of an internal (mucous) and an external coat, and is rather extensible. At the posterior extremity a small lobule is sometimes attached, *parotis accessoria*.

The vessels of the Parotis are numerous: *Artt.* are branches of the *temporal, transvers.* and *auricularis*. *Vv.*, like the nerves, form a *plexus parotideus*, and fall into *V. facial. posterior*. *Vas. lymph.* enter the lymphatic glands at the *angul. maxill.* and those before the *external auditory meatus*.

Nerves: they are branches of *plex. anserinus* and *N. auricular. anter.*

b. The submaxillary gland, *glandula submaxillaris*, oblong, flat, bipartite, placed, partly, on the internal surface of the *basis max. inf.*, covered externally and below by *fasc. cervical., v. facial. ant., m. platysma myoides*, and skin; internally, by *nerv. lingualis* and *hypoglossus* and *m. hyo-glossus*, with a groove (behind) for *Art. maxillar. externa*; meets behind with the post. belly of *m. digastricus*; surrounds in front the posterior border of *m. mylo-hyoideus*; and connected, above the last, with *gl. subling.*, it gives off at this point its excretory duct, the

Ductus Whartonianus, shorter, more delicately membranous, but wider than the *d. Stenon.*, passes obliquely from below upwards, and from without inwards, parallel with *n. hypogloss.* and *lingualis*, at the commencement between *m. mylo-hyoideus* (above this) and *hyo-glossus*, then between *m. genio-glossus* and *gl. sublingualis*, on its internal surface, always close beneath the mucous membrane, and opens at the sides of *frenulum lingue* in the *papilla caruncula sublingualis*, behind the inferior incisor teeth.

Vessels: *Artt.* are branches of *maxillar. externa.*, *Vv.* pass into the *ven. facialis anter.*

Nerves: they come from the *gangl. maxillare nerv. lingualis*.

c. The sublingual glands, *glandula sublingualis*, small, oblong, flat, in a fossa of the lower jaw close to *Spina interna menti*, projects inwards into the cavity of the mouth, covered at this spot with mucous membrane only, close to the *frenulum*; they rest upon *m. mylo-hyoideus* (between the two *gangl. sublinguale*); the internal surface is directed towards *m. genio-glossus* and separated from the last by *N. lingualis, ductus Wharton., V. ranina*. The anterior extremity of

one sublingual gland meets that of the other; the posterior extremity and the inferior border surround the *nerv. lingualis*.

The excretory ducts: 1, *d. Bartholinianus* opens upon the *caruncula sublingualis*, or unites with the *duct. Whartonianus*. 2, *d. Riviani*; from seven to twelve small ducts open along the *frenulum* upon the mucous membrane of the mouth, or are associated with the *ductus Bartholin*.

Vessels: *Artt.* and *Vv.* are branches of *sublingualis*.

Nerves: branches of *ram. lingualis trigemini* with *gang. sublinguale*.

431. 3. The teeth, *dentes*, *mordices*, are bone-like bodies, fixed (*per gomphosin*) into the *alveoli* of the jaws, thirty-two in number (in the full-grown adult), consisting of a soft nucleus surrounded by a hard, brittle, osseous substance (*dentine*) and the *enamel*. The crown, *corona dentis*, projects freely into the mouth, covered with *enamel*; the neck, *collum*, is a smaller portion surrounded by the gums; the root, *radix*, is fixed into the alveolus (socket). Both the alveoli and the roots of the teeth are covered with a delicate, highly vascular periosteum, which enters the cavity in the interior of the tooth through a fine foramen at the extremity of the root, and surrounds the nucleus.

a. Incisor teeth, *d. incisivi s. primores*,

4 superior,

4 inferior,

in the centre, at the anterior part of the *arcus alveolares*. The crown is chisel-shaped, convex in front, concave behind, the free edge sharp and broader than the basis, which is thicker; the root is single (rarely double), conical, flat at the sides, obtuse at the point. The superior incisors are stronger than the inferior, the central (superior) stronger than the external. The superior converge downwards; the external inferior diverge upwards.

b. Corner, canine teeth, *d. canini s. cuspidati*,

2 superior (eye teeth),

2 inferior,

the one by the side of the external incisors, are the longest, especially the superior. The crown thick, irregular, conical, triangular, pointed; the root longer (especially the superior) and thicker than the rest of the teeth, single. The inferior canine teeth are received (when the teeth are closed) between the superior canine and external incisors.

c. Back, masticating teeth, *d. molares*.

10 superior,

10 inferior,

five upon each side, next to the canine tooth. The crown is short, almost cubical, the free extremity quadrangular and uneven; root compound.

We distinguish: 1. *dent. molares minores*; these are the two anterior next the corner teeth. Their crown is small, with two tubercles (*bicuspidati*);

4 superior,

4 inferior;

their root single, flat, or (rarely) slightly bifurcated. The superior are stronger; the root of the second superior *bicuspis* is usually bifurcated.

2. *D. molares majores*, the three posterior back teeth (the last called *dens sapientiæ*), have a low broad crown with three or four tubercles (*tri, quadri-cuspidati*), and two, three, or four at one time parallel, at another diverging, or hooked, curved roots; those of the wisdom teeth are united into a single root. Lent. molar. major.

6 superior,
6 inferior,

[Dental formula:

	Molar. major.	Molar. min. s. Bicuspid.	Cuspidatus s. Canine.	Incisors.	Incisors.	Cuspidatus s. Canine.	Molar. min. s. Bicuspid.	Molar. maj. the last Dent. sapientiæ.
	3	2	1	2	2	1	2	3
	3	2	1	2	2	1	2	3
4		1—1		5—5				
Incisors —	Canines —	Molars —	= 32. TRANS.]					
4		1—1		5—5				

Elements of the teeth.

1. Dentine, *substantia ossea* s. *ebur*, forms the principal mass and the foundation of the teeth, is marrowless and non-vascular, formed of layers not of canals, harder and more transparent than the (common) substance of the bones, of which a thin layer covers the external and internal surfaces of the root of the tooth. It is yellowish white, iridescent, consisting of concentric layers and parallel longitudinal fibres and especially rich in Chondrin. This last is wanting in

2. The Enamel, *subst. vitrea* s. *corticalis*, which covers the crown, is bluish white, very hard (resisting the file) and heavy, presents horizontal fibres, and is said to be deposited from a peculiar organ, *membrana adamantina* (Purkinje).

1. *Subst. ossea.*

Phosphate of lime	-	-	61.95
— magnesia	-	-	1.05
Carbonate of lime	-	-	5.30
Fluoride of calcium	-	-	2.10
Soda and common salt	-	-	1.40
Cartilage and water	-	-	28.00

2. *Subst. vitrea.*

Phosphate of lime	-	-	85.3
Carbonate of lime	-	-	8.0
Phosphate of magnesia	-	-	1.5
Membranes, soda and water	-	-	0.2

3. The nucleus, germ of the tooth, *nucleus s. pulpa dentis*, lies in the cavity of the tooth, *cavum dentis*, the shape of it being determined by that of the cavity; it is a reddish body, consisting of uniting tissue, capillary vessels and nerves, surrounded by a thin and very sensitive membrane. The arteries come from *Art. maxillar. interna.* (*Artt. alveolar. anter., poster., and infer.*); the veins open into *Ven. facialis ant. and post.*; the nerves are branches of *ram. maxillar. super. and inferior* (*N. alveolar. ant., poster. and inferior*).

432. The tissue of the gums, *gingiva* (*ὄλον*), thicker and more firm than the mucous membrane of the mouth, the continuation of which it is, covers the alveolar processes of the jaws, and is connected with the *periosteum* by a very vascular, loose uniting tissue. It turns over the free edge of the alveolus for about a line broad, and then passes into the periosteum of the alveoli. It is provided with the *glandul. tartaricæ*, mucous glands, which deposit the so-called tartar; little sensitive when cut, more when pressed; becomes hard like cartilage after the teeth have fallen out, when it covers over the *alveoli*. Arteries: *coronar. super., submental., sublingual.* Nerves: from *n. quintus*.

433. Development of the Teeth.

a. Before their eruption. The jaws of a two to three months' fœtus present a broad and deep fossa, which is divided by thin septa into cells, and closed upon the free border by a whitish and firm fibrous tissue (dental cartilage).

At the time when the dental sacculi form, prolongations of the dental cartilage go to the floor of each cell, line it from without, and leave a small opening, only, for the entrance of the vessels and nerves.

The dental sacculi, *folliculi dentium*, are closed membranes, filled with a reddish, viscous fluid, four of which appear in the middle of the third month, and six in the fourth month, in each jaw.

The tooth germ, *pulpa dentis*, elevates itself at first in the fourth month, from the floor of the sacculus, as a papilla-shaped body, the thin pedicle of which forms the dental vessels and nerves, increases by degrees into the sacculus, it becomes the nucleus about which the tooth (the crown first) forms. In the fifth month ossification commences, that is to say, thin elastic discs of *dentine* are deposited upon the surface of the *pulpa*, and indeed, so many as the tooth at a later period is said to have tubercles. At a later period they coalesce and become strengthened by new discs annexed to them from within. But the enamel is not deposited from the *pulpa*, nor even from the reddish fluid which washes round it, but from the lamina of the dental sacculus turned towards the cell, and, indeed, from an enlargement at the top of the crown to which last it is applied, at first (even in the mature fœtus) as a soft and moist mass.

In the fifth month the central, then the external, incisor teeth form and become ossified; in the sixth month, the first molar, the canine, the second molar teeth.

b. Eruption of the (milk) teeth, dentition, *eruptio dentium, dentitio prima*. When after the birth of the child the roots of the teeth have reached the floor of the dental cells, the gum, in consequence of their farther growth, is pressed upon, inflames, and thence becomes perforated.

It happens in the following order. At the seventh month the central inferior, after them the remaining (generally, the central superior, first) incisor teeth; at the end of the first year the first molars; in the middle of the second year the inferior canine, later the superior, and, at the end of the second year, the second molars; in the whole twenty teeth.

[Formula: incisors $\frac{4}{4}$; canine $\frac{1-1}{1-1}$; molars $\frac{2-2}{2-2} = 20$. TRANS.]

These milk temporary teeth, *d. lactantes s. temporarii*, remain until the or seventh year, when they make room for the permanent, *d. permanentes*. The milk teeth are smaller and narrower, the crown and root do not pass gradually into one another, but are separated by a kind of circle; the (superior) first temporary molar has three roots (the permanent only one); the (inferior) first temporary molar, a crown with several and sharp points, and a double root; the second temporary molar a broad crown and five points, with a double or three-fold root.

c. The change of teeth, *mutatio dentium, dentitio secunda*. The (thirty-two) permanent teeth are also developed from dental sacculi, of which those which ought to occupy the places of the twenty temporary teeth are situated in the same cell with them, the twelve to be newly added in their own proper cells. The germs form in the following order: in the fifth month of embryonic life the germ of the third molar tooth arises, in the eighth month that for the remaining incisor teeth, at the end of the first year that for the canine, and rather later that for the fourth molar; in the eighth month after birth the germ for the first and second; in the fourth year that for the last molar.

The decadence of the temporary teeth is preceded by a diminution of the artery which passes to each, whereby the root of the tooth is first absorbed, and the bony canal of the artery contracted; then, in the ninth year, quite closed.

The eruption of the permanent teeth takes place in the following order:

In the seventh year appear	{	The middle pair of the superior, later, that of the inferior Incisors.
		The three Molar teeth.
In the eighth year	{	The inferior external, later, the superior external Incisors.
In the ninth year		The first and second Molars (below and above).
In the twelfth to the thirteenth year	{	The Canine.
In the fourteenth or later		The fourth Molar, and
Between the twentieth and thirtieth	{	The last or wisdom teeth.

d. The decadence of the teeth in old age is normal, and appears to be effected by the pulp of the tooth, by degrees, ossifying, and the nourishing vessels becoming obstructed. The cells also in which the teeth are seated fill with bone earth (the teeth become apparently longer), their edges become absorbed, and, in consequence, the jaws lower, the gum, after the decadence of the teeth, draws over the free surface, and becomes cartilaginous (as it was before in the suckling). The decay of the teeth appears also to be in connection with the grinding away and loosening of the enamel; the crown is already worn even before the teeth are completely perfect.

Anomalies in the number of the teeth. Most frequently the wisdom,

sometimes the first molar, rarely the external incisor teeth, remain undeveloped. Occasionally some molar teeth exceed the number (more frequently in Negroes). With many children the eruption of the milk teeth takes place before birth. A third mutation sometimes occurs with the posterior molar and the incisor teeth.

434.

5. The Pharynx,

a funnel-shaped muscular semi-canal behind the nasal and oral cavities and the larynx, in the central line before the five superior cervical vertebræ, at the superior part called the *fauces*, is closed above, behind and at the sides, but before and below (where it passes into the œsophagus) open. Narrower than the *mouth*, but wider than the *œsophagus*, its breadth measures above (between the posterior borders of the internal wings of the *P. ptérygoidei*) about one inch, farther down (between the posterior extremities of the alveoli) two inches [during contraction of the muscles only one inch], still deeper (between the *inferior cornua* of the thyroid cartilage) rather above one inch [to almost complete closure during contraction of the muscles]. Length: four to four and a half inches [may be elongated to about five and a half, shortened to two and a half inches].

The external surface is formed of a muscular coat, behind, united with the *fascia cervicalis (profunda)* by loose uniting tissue, and is situated before *mm. recti capit. antic.*, and *longus colli*; is at the sides separated from *m. pterygoideus intern.* by a triangular (below broad) space, in which are found: *Carotis interna*, *V. jugular. intern.*, *Nn. vagus*, *glosso-pharyng.*, *hypoglossus*, *accessor. Willis.*, farther down many lymphatic glands and *Carotis externa*. Above (the roof) it is attached to the *pars basilar. ossis occipitis*.

The internal surface is covered with mucous membrane. The anterior wall is wanting; instead, we see: 1. The two posterior nasal openings. 2. The superior surface of *velum palatinum*, above which the fluid from the nose flows into the posterior part of the mouth. 3. The semicircular *isthmus faucium*. 4. The superior opening of the larynx closed by the *epiglottis*. 5. The posterior surface of the larynx. The posterior wall is even broader above than below. The lateral parietes with the opening for the *tuba Eustachii* (at the same elevation as the posterior extremities of the inferior turbinate bones).

The limit between the *pharynx* and *œsophagus* is indicated by: the narrowness of the tube, the paleness and the altered direction of the muscular fibres of the latter.

Muscles (see Myology). *Fasciæ*: 1. *F. pharyngea posterior* arises from the inferior surface of *pars basilaris, tuba Eustachii*, and serves for the attachment

of the *mm. constrictor pharyng.* 2. *F. pharyngea lateralis* arises from *os petrosum* (at the internal border of the inferior opening of *canal. caroticus*), passes to the lateral wall of the *Pharynx*, attaches itself in the *fossa pterygoid.* between *m. pterygoid. intern.* and *circumflex. palati*, with a process to the *m. buccinatorius*, covers the tonsils, and attaches itself to the superior border of *os hyoideum*.

Vessels: Branches of *Art. pharyngea ascendens, thyreoidea super. and infer., palatina ascend. and pterygo-palatina.*

Veins: they form *plex. pharyngeus.*

Nerves: *plex. pharyngeus superior and inferior* (from *N. vagus, glosso-pharyngeus, accessor. Willis. and sympatheticus*), and *ganglion spheno-palatinum.*

435.

6. The Œsophagus,

a flat, extensible, muscular canal, from eight to nine inches long, reaches from the fifth cervical vertebra as far as the tenth dorsal, that is, from the inferior opening of the pharynx to the superior of the stomach; narrowest in the cervical region, widest at the inferior extremity; and closed in the remaining portion, since the anterior comes in contact with the posterior wall.

a. Cervical portion: 1. covered in front by the *trachæa*, to the left (as the œsophagus deviates to the left) by *m. sterno-thyreoidæus (sinister)*, the *thyroid gland, N. recurrens (sinist.), Art. and Ven. thyreoidea infer.,* connected above by condensed uniting tissue with the *trachæa*; 2. behind, attached by loose uniting tissue to the vertebral column; *N. recurrens dexter*; 3. at the sides: the thyroid gland, *Carotis communis, Ven. jugularis interna.*

b. The thoracic portion passes along the *posterior mediastinum.* 1. Before it are placed: the *trachæa*, and farther down the *bronchus sinister, arcus aortæ*, and lastly the *pericardium* (with the basis and posterior surface of the heart); below *n. vagus sinister.* 2. Behind it: the vertebral column; separated from it by uniting tissue, *lymphatic glands, Ven. azygos and ductus thoracicus* (above); quite below: *Aorta thoracica* and *N. vagus dexter.* 3. At the sides: the lungs, separated from it by the middle mediastinum; the whole length of *N. vagus*; to the right (from the fourth dorsal vertebra) on *ven. azygos, duct. thorac.*; to the left: *Aorta thoracica.* In the thoracic portion the œsophagus projects in a more marked manner to the right.

c. The abdominal portion, very short (rarely an inch), passes through *foram. œsophageum* of the diaphragm, and is immediately enveloped by *peritonæum* before and to the right of the left lobe of the liver, behind embraced by *lobulus Spigelii.*

Structure. 1. Muscular coat, *tunica externa*, thick, above red, below paler; consists of an external layer of longitudinal fibres, which descend from the posterior surface of *Cartilago cricoidea*, and are lost in the first layer of the

muscular coat of the stomach; and of an internal layer of circular fibres, which are lost in the third layer of the muscular coat of the same organ.

2. Mucous membrane, *tunica interna*, is connected with the last by a thin layer of uniting tissue (*tun. propria* s. *nervea*) of a whitish and wrinkled (rugous) appearance, with long folds beset with oblong mucous glands and pavement epithelium. The *œsophagus* is surrounded externally by lymphatic glands (*gland. mediastinæ posticæ*).

Vessels: *Artt. œsophageæ* come to the cervical portion from *thyroid. infer.*; to the thoracic: 1, direct from the *Aorta*; 2, from *bronchiales*; 3, from *intercostales* (sometimes *mammariæ interna*; to the abdominal portion: from *coronar. ventric.* and *phrenicæ inferior*.

Veins correspond to the arteries, and open besides into *Ven. cava. sup.* and *azygos*. Lymphatic vessels enter the numerous glands around the *œsophagus*.

Nerves: *vagus* and *ganglia thoracica* of *nerv. sympathicus*; form plexuses before and behind the *œsophagus*.

b. Parts below the Diaphragm.

436. 1. The Stomach, *ventriculus*, *stomachus*,

a membranous, curved sac, the shape of a flattened cone, which is situated transversely in the superior region of the abdomen, below the diaphragm, filling up the left *regio hypochondriaca*, and extending as far as the right (passing through the *reg. epigastrica*).—Direction: oblique from above downwards, and from left to right. In this position it is maintained by *Æsophagus*, *Duodenum*, and a fold of *Peritoneum* which attaches it to the *Liver* and *Spleen*.

Parts of the Stomach: 1. Anterior wall; this is directed forwards and somewhat upwards, covered above by the heart, to the left by the six last ribs, separated by the Diaphragm, to the right by *lobul. quadrat.* of the liver, and before by the anterior abdominal parietes (*reg. epigastrica*).

2. The posterior wall looks downwards and backwards, is placed above the *Colon transversum*, before the *Duodenum* and *Pancreas*; and rests upon *Mesocolon transvers.*

3. *Curvatura Major*, that is, the inferior convex border which, in the distended stomach, looks forwards, and to which the two anterior laminæ of the great omentum are attached (at this point *Artt. gastro-epiploicæ*).

4. *Curvatura Minor*, that is, the superior concave border between *Cardia* and *Pylorus*. In the full stomach it looks upwards and backwards, separated from the vertebral column by the *Aorta* and Diaphragm; surrounds the small lobes of the liver, the *tripus cæliacus* (Halleri) [*cæliac axis*] and *plexus solaris*; to it is attached the small omentum.

5. *Fundus ventriculi*, base of the stomach. This includes the entire portion of the stomach situated to the left of the *Cardia*,

and terminating in a cul-de-sac. It is round, large in circumference, separated by the Diaphragm above, from the lungs, before, from the six last ribs, applied, outwards, against the spleen (thence *portio splenica*), and united with it by *Lig. gastro-splenicum* and *Vasa brevia*; behind, against the *Pancreas*, *left Kidney*, and *Caps. supra-renal*.

6. *Pars pylorica*, at the right extremity of the stomach, is bounded at its junction with the wider central portion of the organ by a slight contraction, but at its union with the *Duodenum*, in which it terminates, by a stronger; before which, at the distance of one inch from the stomach, it takes a considerable curve (upwards), and forms a small blind sac; it looks to the right, backwards and upwards; lies under the liver and the small omentum, above the great, before the *Pancreas*, behind the abdominal walls between *reg. epigastrica* and *hypochondriaca dextra*; not uncommonly close to the gall-bladder.—*Pylorus* s. *ostium duodenale* is situated behind the *lobulus quadratus* of the liver, leads into the *Duodenum*, from which it is shut out (inwardly) by a valve, *valvula pylori*.

7. *Cardia* s. *ostium œsophageum*, the mouth of the stomach, lies at the left superior portion of the stomach between *Curvatura minor* and *Fundus ventriculi*, close under *foram. œsophag.* of the Diaphragm (with *lig. phrenico-gastricum*), embraced in front by the left border of the liver, behind by the *lobulus Spigelii* (behind the so-called *cardiac fossa*; yet not always). The width of *Pylorus* and of *Cardia* measures about one inch.

Structure of the Stomach.

a. The mucous membrane, villous coat, a continuation of that of the œsophagus, forms the most internal coat of the stomach. Very thin and extensible, thicker and more solid than in the *pars pylorica*; it presents on its internal free surface, covered with thin epithelium, a number of delicate linear elevations, *villi*, and between them innumerable openings of gastric juice glands (surrounded by pentangular or hexangular vascular meshes), which are particularly strongly developed in the *pars pylorica*; on the *Cardia* the laminated *glandul. lenticulares*, which do not open upon the surface. Besides numerous folds which pass from the *Cardia* towards the *Pylorus* longitudinally, in straight or wavy lines, intersected by others in an oblique direction, and which serve for the enlargement of the stomach. A similar circular fold of mucous membrane, between the layers of which the *m. sphincter pylori* lies, forms the *Valvula pylori*.

Besides the gastric juice, it secretes the common mucus.

b. *T. vasculosa* s. *nervea* is connected very firmly with the following, and only loosely with the mucous membrane.

c. *T. musculosa* consists of three layers of pale red muscular fibres:

1. The external layer, formed of longitudinal fibres, which spread themselves out from the *œsophagus* upon the *cardia*, and thence, in a radiated form, upon *fundus* and *curvatura major*, arranged along the *curvatura minor* like a band, are thicker and coarser at the *pylorus*, and pass over upon the *duodenum*.

2. The middle, strongest layer, consists of circular fibres, which pass from the *œsophagus* to the *valvula pylori*, and terminate in the last with a thick ring, as *m. sphincter pylori*.

3. The internal layer consists of oblique fibres (continuations of the circular fibres of the *œsophagus*), which pass with a parabolic curve from the *cardia*, and surround, especially, the *fundus*.

c. *Serosa*, the most external coat, is firmly attached, at some distance from the curvatures, to the muscular coat; it consists of two layers of *peritoneum*, which pass from the liver to the stomach at the *curvatur. minor*, cover its anterior and posterior surfaces, unite again at the *curvatur. major*, and form at this point the great omentum (see Peritoneum).—Ligaments: *omentum minus (gastro-hepatic.)*, *lig. phrenico-gastricum*, *splenco-gastricum*.

Vessels. 1. *Art.* at the small curvature: *coronaria ventric. sinistra* (from *A. cœliaca*); *coron. ventr. dextra* (from *hepatica*); on the great curvature: *gastro-epiploicæ* (from *hepatica* and *lienalis*); at the *fundus*: *Artr. breves* (from *A. lienalis*); at the *pyloric* end: *gastro-duodenalis*. 2. Veins, the same names taking a like course, collect in *V. lienalis* and *coronar. ventr. dextra* and open into the *V. portæ*. Lymphatics: pass into the glands along both curvatures.

Nerves. 1. *N. vagus sinister*, forms a *plexus gastricus* on the *ant. surface*; *nerv. vagus dexter*, a similar on the posterior surface of the stomach; shortly (both) around the *Cardia*, and they are lost in the muscular coat. 2. *Plexus cœliac*, formed by *Nerv. sympathicus*.

Development. In the *fœtus* the *fundus* is small, the whole stomach directed vertically; in old age the *pyloric* portion, and especially *m. pylori*, is greatly developed.

Function. *Chymification*, that is, the metamorphosis of the food into *Chyme*, by means of the acid of the gastric juice (see Pepsin).

437. 2. Intestinal canal, *canalis s. ductus intestinalis*,

a tubular, membranous, greatly convoluted conduit, reaching from the Pylorus to the Anus, and filling up the largest portion of the lower belly. It is divided into a superior, longer, and at the same time narrow portion (small intestines), and an inferior and also wider (large intestines). Their coats are, from within outwards.

1. Mucous membrane. 2. *Tunica propria s. nervea*, a thin, brilliant, white uniting tissue, firmly connected to the mucous membrane and the interposed uniting tissue of the muscles, and on this account is not generally expressly mentioned. 3. The muscular coat, consisting of an *internal* layer of delicate *circular*, and an *external* of *longitudinal* fibres (according to Mussy four layers). 4. The serous coat or peritoneal investment.

438. a. The small intestine, *intestinum tenue s. angustum*, extends from the *regio umbilicalis* and *hypogastrica*, through the *reg. lumbalis* as far as *reg. iliaca dextra*, where it enters the

commencement of the large intestine (*cæcum*), and is separated from it by a valve (*valvula Bauhini*) [*Ileo-cæcal* and *Ileo-colic*]. We divide it into: Duodenum [equal to the breadth of twelve fingers] and mesenteric intestine (that is, *Jejunum* and *Ileum* associated together). The small intestine is distinguished by its greater length (fourfold), its narrowness, and its structure, from the large.

The mucous membrane of the small intestine is paler than that of the stomach, and presents on its internal free surface, *valvula conniventes*, *villi*, and glands.

1. *Valvula conniventes Kerkringii* consist of folds of the mucous membrane, inside of which loose uniting tissue, vessels and nerves only are found. They are placed vertically to the axis of the intestine, form one-half, two-thirds, or three-fourths of a circle, are broadest in the centre (two to three lines), and lie more or less parallel, close to, or in, the empty intestine, in an imbricated manner over one another. They commence one to two inches below the *Pylorus*, increase in number to about two-fifths of the mesenteric intestines, and then decrease, until at the termination of the last they are altogether wanting. The superficies of the intestine is said to be increased by their presence about two, three, or even six fold.

2. *Villi (papillæ)* cover the entire small intestine, the *valv. conniventes* as well as the depressions between them. Number: undetermined; 4000 upon one square inch. Length = 0.2 to 0.8 of a line. Shape: foliaceous (in man), filiform (in the dog, cat); different in other animals. Structure: each villus consists of uniting tissue, like the papillæ of the corium and tongue, extending into a sheath of Epithelium (Henle); but containing, instead of nervous plexuses, a minute ramification from the lymphatic rete, surrounded by capillary vessels (according to Lieberkühn a cavity, *ampulla*, at the basis, and an opening at the point, from which the Chyle-vessels proceed). The absorption of the Chyle in all probability takes place without an opening in the villus.

3. Glands: a. *Gland. solitariae*, simple mucous follicles, are dispersed through the whole of the small intestine; they are the size of a millet seed, push forward the mucous membrane beset with papillæ, are hollow, (generally), closed, but surrounded by a coronet of obliquely placed open tubules (*gland. Lieberkühnianæ?*), which are said to communicate with their cavity (Krause). They contain a clear, white, or granular substance, and are sometimes open, in a congested condition, appearing then as inversions of the *Mucosa* (Henle).

b. *Gland. Peyerianæ* are distinguished from the solitary, merely by their occurring in masses (*gl. agminatae*), and possessing thinner walls which, like those of the latter, are also structureless. These accumulations of glands are elliptical, lying in the longitudinal axis (of the small intestines) on the convex border, opposite to the attachment of the mesentery; particularly abundant at the termination of the *Ileum*, decreasing in number towards the *Duodenum*. They are also surrounded by a coronet of tubules, and are sometimes open.

c. *Gland. Brunnerianæ (pancreas secundarium)* are flat, oval, lenticular, racemose glands, divided into lobules (*gl. acinorum compositæ*), which project more outwardly than towards the mucous membrane. Disseminated in masses they are found in the *pars horizont. super.* of the *duodenum*, but only singly. They open with wide mouths.

d. *Gland. s. cryptæ Lieberkühnianæ* are very small eversion of the mucous membrane externally, which give to the last a cribriform appearance, lie between the basis of the villi, and are said to contain the commencements of the lymphatics.

439. a. *Duodenum*, the bile intestine, equal in length to about the breadth of twelve fingers (eight to eleven inches), commences at the *Valvula pylori* and terminates without any definite boundary line to the left of the lumbar vertebræ, behind the *art. and ven. mesenterica superior*. Figure: in the form of a horse-shoe, with the concavity directed to the left, in which we find the head of the *Pancreas*.

1. The superior portion, *pars horizontalis superior*, about two inches long, passes to the right and backwards, from the *pylorus* to the neck of the *gall bladder*, which lies over it and is attached to it by a fold of peritonæum. It is more moveable than the following parts. Before it lie the *lig. gastro-colic.* and the *abdom. walls*. Behind it, *Vasa hepatica* and *lig. gastro-hepatic*.

2. The descending portion, *p. descendens* (s. *renalis*), two to two and a half inches long, describes above, with the last portion, an acute angle, descends vertically rather to the left (of first to fourth lumbar vert.), behind the right extremity of the *Colon transv.*, crossing with it, before the concave border of the right kidney, close to *Ven. cava* and *duct. choledochus*. Below the centre of the posterior internal surface the *duct. choledoc.* and *pancreat.* open into it. On its right side, *Colon ascendens*; on the left, the head of the *Pancreas*.

3. The inferior portion, *p. horizontalis inferior*, passes off at a right angle with the last portion backwards and to the left, separated, before, from the stomach by a layer of omentum; behind, from the vertebral column by the *Aorta*, *V. cava*, and the crura of the Diaphragm; along its superior border, *Pancreas*; at the inferior border, *meso-colon transversum*.

Structure. a. The mucous membrane of the *Duodenum* is distinguished from that of the rest of the small intestines by:

1. In the *pars horizontal. sup.*, the *valv. conniventes* are wanting.

2. The *villi* are cup-shaped, or in the form of a chaplet.

3. *Gland. Brunner.* predominate, especially in the superior half, and are lost at the inferior extremity, where they pass as *gland. solitariae* over the rest of the small intestines.

4. *Gland. Peyerianæ* are (almost) entirely wanting.

5. On the posterior internal wall (at the inferior extremity) we find the opening of *duct. choledochus* and *pancreaticus* united together or separate (*diverticulum Vateri*).

b. The muscular coat is thicker in the *Duodenum* than in the remainder of the small intestine.

c. The serous (*Peritonæum*) covers the *p. horizontal. super.*, above and below only, and passes, in front, into the large, behind, into the small omen-

tum; the descending and inferior portions are only covered by it in front, their posterior surface being attached by uniting tissue to the parts lying behind. The Duodenum is therefore little moveable.

Vessels: *Art. and Ven. gastro-duodenalis* (from the *Hepatica*) for the superior portion, *Art. mesenterica super.* for the inferior.—Lymphatics: they pass into the glands above the *Pancreas*.

Nerves: they come from *Plex. celiacus* and *hepatic*.

Function of the Duodenum: the metamorphosis of the *Chyme* into *Chyle* by the bile and the *succus pancreaticus*.

440. b. The *Jejunum* (the empty) and *Ileum* (the convoluted) mesenteric intestine, the most moveable, attached by a fold of *peritonæum* (*mesenterium*) to the vertebral column and the longest portion of the small intestine, passes from the termination of the *duodenum* at first backwards and forwards and from right to left, winds in many convolutions (*gyri*) through the *reg. umbilicalis* and *hypogastrica* into the small pelvis, whence it ascends, lying between rectum and bladder, transversely from left to right, and (before *m. psoas*), to enter vertically the large intestine. Commencement: to the left of the second lumbar vertebra; termination: in the *fossa iliaca dextra*. The interval between the two points being four inches in length. The length of the mesenteric intestine measures nineteen feet; the width in the superior part = 6—4 inches, in the centre = 4—2, at the terminal portion = 3—5, and at the termination itself = 4—5. The greater the width the more deficient in length. Shape: cylindrical. To the posterior concave border the *mesenterium* is attached. The anterior convex border is separated from the abdominal parietes by the great omentum. Each convolution is almost entirely circular.—It is not uncommon to find at the inferior part of the mesenteric intestines finger-shaped appendages (*diverticula*), two to three inches long, which occasion *herniæ* (*herniæ Littriciæ*).

Structure. a. The mucous membrane is distinguished by:—

1. *Valv. conniventes Kerk.*

2. *Glandul. Peyerianæ*, on the anterior intestinal wall.

3. *Valvula Bauhini* s. *Fallopia* s. *Tulpia* s. *Ileo-cæcal* consists of a fold of mucous membrane which projects into the large intestine at the termination of the small, becomes reflected, and passes over upon the cæcum. Between the two layers of the fold (valve) lie circular muscular fibres. The ends of the valve are called *Fremula Morgagni*.

[Another fold projects towards the colon, *V. Ileo-colic*.]

b. The muscular coat is thinner at the commencement than farther down.

c. The serous coat (*Peritonæum*) completely covers the mesenteric intestine, except a small stripe at the part to which the two layers of the mesentery are attached.

Vessels: *Art. intestinales* from the *a. mesenterica super.*; Veins: they open in the *V. mesenterica major* (branch of *Ven. portæ*); the Lymphatics are the Lacteals, and go into the glands of the mesentery.

Nerves: from *plexus mesentericus*.

Function of the mesenteric intestine: absorption of the *Chyle*.

441. c. The large intestine, *intestinum crassum* s. *amplum*, extends from the *Valvula Bauhini* as far as the *Anus*, surrounding the small intestine almost like a ring, since it ascends from the inferior part of *reg. iliaca dextra* into the *r. hypochondriaca dextra* as high as the liver, passes from this point with a sudden turn transversely across, below the stomach, to the left side as far as the spleen, curves once more and descends vertically as far as the *reg. iliaca sinistra*, whence it sinks down into the small pelvis forming the *sigmoid flexure*, and terminates with the *rectum*. Its length measures four to five feet, its width varies (see below).

Shape: tubular with irregular surfaces.

Structure: 1. Mucous membrane, whiter, thicker, and coarser than that of the small intestine, contains no *villi*, but, instead, irregularly arranged folds, between which numerous mucous glands open (*gl. Lieberkühn.*); no *valvula conniventes*, but, instead, crescentic transverse and longitudinal folds.

2. The muscular coat is stronger than in the small intestine.

3. Serous coat (*Peritonæum*) less complete than in the mesenteric intestine; the *Colon transvers.* alone has a complete mesentery. It forms in several places, especially on the *Colon*, semi-circular, depending folds, beset with fat (*appendices adiposæ* s. *epiploicæ*), which wind around and tie together the intestine.

Function: For the formation, keeping, and expulsion of the fecal matter. In the fetus the large intestine is filled up with *meconium*.

442.

a. The *Cæcum*,

is the most superior portion of the large intestine, ending in a cul-de-sac. It lies in the *fossa iliaca dextra*, covered on the anterior surface only by *peritonæum*, and therefore little moveable; (it nevertheless sometimes sinks down into the pelvis, and contributes to form herniæ;) generally in a vertical direction (that is, in the same as *Colon ascendens*;) next to the stomach the thickest part of the alimentary canal; of an oblong, sacciform, and irregular shape, provided below (behind and to the left) a few lines beneath the *valv. Bauhini* and above its terminal cul-de-sac, with a process, *proc. s. appendix vermiformis* (one to six lines long), about as thick as a goose-quill, and terminated by a closed end, which is attached by a triangular fold of *peritonæum* (*mesenteriolum appendicis*), and is frequently pushed between *colon ascend.* and kidney.

In front the cæcum touches the abdominal parietes. (The small intestine often passes between them.)

Behind it rests upon *M. iliacus intern.*, separated from it by *fasc. iliaco-lumbalis*, and from this by loose uniting tissue.

Internally the *Cæcum* receives the small intestine at an obtuse angle above.

Structure. The mucous membrane presents: 1. Pocket-like recesses which correspond to the elevations, and transverse folds corresponding to the indentations on the outer surface of the intestine.

2. *Valvula Bauhini* s. *ileo-cæcalis* (see small intestine). The fold which passes from the Cæcum, has entirely the characters of its mucous membrane. [Depressions, or alveoli, are seen on the surface of the m. membrane of Cæcum.]

3. The opening of the vermiform process.

4. The muscular coat consists of longitudinal fibres, which are bound up in three flat stripes (*tæniæ*) as broad as a finger, and with transverse circular fibres, by which the vesicular and cellular elevations (*cellulæ, loculamenta*) are formed.

5. Serous coat (*peritonæum*) is wanting on (upper part) the posterior surface of the intestine.

Vessels: branches of *Art.* and *Ven. ileo-colica* (*appendicularis, &c.*), from *mesenter. superior*.

Nerves: come from *plexus mesenteric. sup.*

443.

b. The Colon,

encircles the mesenteric intestine in the shape of a horse-shoe, commencing without any distinct boundary line in the *reg. iliaca dextra*, making a first curvature in the *reg. hypochondriaca dextra*, a second in the *reg. hypochond. sinistra*, and a third in the *r. iliaca sinistra*, in which it terminates with a sigmoid flexure. Hence four portions arise.

1. *Colon ascendens* s. *dextrum* bounded below by the Cæcum, terminates as high as the gall bladder; is covered before by the peritonæum and the abdominal walls (from which it is sometimes separated by the small intestine), behind by *M. quadrat. lumb.* and the right kidney (without peritonæum and only fixed to the uniting tissue). On the inner side lie small intestines (as on the external), *m. psoas* and *p. transv. duodeni*.

2. *Colon transversum* passes off at a right angle from the last, below the stomach to a point under the spleen, is convex before, concave behind, and very moveable (is often found in herniæ). It corresponds above with the liver and gall bladder, the stomach and the inferior extremity of the spleen; below, with the small intestines; before, with the abdominal walls (separated from it by the two anterior layers of the great omentum); behind, with the *mesocolon transv.* (mesentery, by which it is separated from *Doudenum* and *Pancreas*).

3. *Colon descendens* s. *sinistrum* passes first backwards, then forwards, on the posterior abdominal wall, before *m. quadrat. lumbor.* and left kidney; commences rather deeper than 1., and terminates in the

4. Sigmoid flexure, s. *flexura iliaca*, which lies in the *fossa iliaca sinistra*, before, covered by the abdominal walls (in a state

of distension), at the sides by the small intestines; is attached, behind, by *mesocolon*, and is very moveable. At the commencement it rises somewhat upwards and backwards (to *musc. iliac. intern. sinist.*), then descends vertically; the termination curves right or left, forwards or backwards as high as the *basis oss. sacri*, where the *rectum* commences.

Structure. The external surface of the Colon presents, like that of the *Cæcum*, the *taniæ* and *loculamenta*. On the *Colon descend.* and *Sigmoid flexure* there are only two rows of elevations; these disappear lower down.

Mucous and muscular coat (see large intest.).

Serous coat (*peritonæum*) covers the *colon ascendens* and *descendens* on the anterior wall, only, on which account the last is little moveable. On the contrary the *Colon transvers.*, completely enveloped (*mesocolon trans.*), and, like sigmoid flexure, is very moveable.

Vessels: For *colon ascend.* and right half of *transv.* branches of *Art. mesenterica superior*, *Ven. mesent. major*; for the remainder of the Colon: *Art. mesent. infer.* and *Ven. mesent. minor*.

Lymphatics: open into the glands on the attached border.

Nerves: Branches of *plex. mesentericus sup. et inferior*.

444.

c. The Rectum,

the most inferior part of the intestinal canal, lies on the posterior wall of the lesser pelvis in the curvature before the sacrum and coccyx, commencing to the left of *basis oss. sacri*, and terminating with the anal opening, *anus*, under *fundus vesicæ* (or *vagina* in the female), surrounded and attached all round by uniting tissue. Curved, in front concave and behind convex, it inclines at the apex of the coccyx rather backwards, and is removed from the *vagina* (in the female) and from the *urethra* (in the male). Posterior surface: above to the left, before the *Symphys. sacro-iliaca sinistra*, separated by *m. pyramidalis*, *plex. sacral.* and *vasa hypogastrica*, attached by mesorectum, below to the left of *os coccyg.*, covered by *m. levator ani*. From its middle (on three false vertebræ of the sacrum) to its termination before the middle line. The anterior surface (above free) corresponds in the male: 1. To the posterior surface of the urinary bladder (from which it is separated, when filled up, by the small intestines), below to the *undus vesicæ* (separated by the two *vesicul. seminales*). 2. The *Prostata*, which projects over one of the two sides or both. 3. The *pars membran. urethræ* (separated by a triangle, the apex backwards and upwards). In the female: 1. The superior free portion, the *lig. latum*, *Ovarium*, *tuba Fallopiæ sinistra*, *Uterus* and *Vagina*. 2. The inferior part close behind *Vagina*.

At the sides are situated, above, small intestines, below, uniting tissue.

Structure. 1. The mucous membrane is stronger and more red than in

the rest of the intestines; it presents longitudinal folds (*columnæ rugarum recti*) which disappear by distension; besides at the commencement and anus a circular fold (*plica annularis*).

2. The muscular coat, like the mucous, is similar to that of the *œsophagus*; it forms *m. sphincter ani internus*.

3. The serous coat (*peritonæum*) covers the anterior surface (of the superior half only). From the *promontorium* to the *rectum* there is a fold; this is, *meso-rectum*.

Vessels: *A. hæmorrhoidalis interna* (from *A. mesent. infer.*), *hæmorrh. med.* (from *hypogast.*), *hæmorrh. inferior* (from *pudenda intern.*).—*Vv.* form *plex. hæmorrh.*, from which arise *Vv. hæmorrh.* (connection with *Ven. portæ*).—

Nerves: branches from *plex. hypogastricus* and *sacralis* (for voluntary motion), and of *N. sympathicus* (for involuntary).

The Anus, *Orificium Ani*,

a narrow fissure, dilating in a circular form, lies in the central line at the posterior part of the perinæum, one inch in front of the coccyx, between the tuberosities of the *Ischia*, and is generally closed. Its skin is brownish, rich in sebaceous glands (in the male beset with hair), and passes in wrinkles into the mucous membrane of the *rectum*.—Muscles: see *sphincter* and *lev. ani*.—Arteries: branches of *Hæmorrhoidales*.—Veins: very numerous, convoluted, plexiform; the most external roots of *ven. portarum*.—Nerves: numerous from *plex. sacralis* and *sympathicus*.

Meconium, a thick, viscous, scentless, dark green mass, fills the large intestine of the fœtus, and the younger the subject so much the more in quantity. In the small intestine we find, instead of it, a thin, yellow, sometimes colourless mucous fluid.

445. Appendages. 1. The Liver, *Hepar, Jecur*.

The liver is a glandular organ, for the purpose of secreting bile. Very large, oblong, quadrangular, it lies close under the diaphragm, enveloped by peritonæum, protected externally by the seventh and eighth last ribs, in *reg. hypochond. dextra*, and reaches in a transverse and oblique direction as far as *reg. hypochond. sinistra*. Weight: four to five pounds. Transverse diam.: ten to twelve inches. Length (from behind forwards): six to seven inches. Thickness: four to five inches. Spec. grav.: 1.5.

a. Surfaces. 1. The superior surface, *pars gibba*, smooth, convex, to the left more flat, lies close under the vault of the diaphragm, and before on the abdominal walls, divided by *lig. suspensorium* into a larger right and a smaller left portion (lobes). They are separated by the diaphragm from the concave basis of the right lung, from the heart, and from the (seventh and eighth last) ribs; touches the abdominal walls in the *reg. epigastr.* and under the right short ribs (where it comes forward, especially in sitting, when the body is inclined forwards).

2. The inferior surface, *pars sima*, concave, directed backwards and outwards, lies over the right kidney, the *flexura coli dextra*, *colon. transvers.*, *pars pylorica ventriculi*, *duodenum*, and small omentum. It presents in the centre two longitudinal grooves (*fossæ longitudinales*), which are united by a transverse groove (*foss. transv. s. Porta*), whereby an H-shaped excavation is formed,

and the inferior surface is at the same time divided into four lobes, viz., a left, an anterior central, a posterior central, and a right lobe.

REMARK. Many anatomists distinguish only a right (six times larger than left) and a left inferior lobe, the boundary between them being the left longitudinal fissure.

a a. The lobes. 1. The left lobe of the liver, *lobus hepaticus sinister*, smaller (also on the superior surface) than the right, lies on the left side of the H, is before concave (for the convexity of the stomach), as well as behind (for the lobul. Spigelii, which the small ormentum separates from it). It reaches sometimes as far as the Spleen.

2. Anterior central, *lobulus quadratus*, before the transverse fissure, in the centre of the H, quadrangular, small, terminates behind (frequently), nipple-shaped.

2. Posterior central lobe, *lobulus Spigelii s. caudatus*, behind the transverse fissure, between the posterior part of the right and left lobes of the liver, to the right of the *Cardia*, on the *Curvatura minor*; flat, crescentic, convex on the free inferior border, which corresponds to the superior border of the *Pancreas*; in the centre provided with a tubercle, *tuberculum papillare s. triangulare*, surrounded by an anterior vascular ring (*A. coronar. ventric., hepatic., splenic.*); a small longitudinal projection (*tuberc. caudatum*) passes on the anterior part, obliquely, from the *Porta* to the right lobe, forwards, and separates the *impressio renalis* from the *impress. colica*.

4. Right lobe of the liver, *lobus dexter*, smaller than upon the superior surface, to the right of the two last described, separated from it by the right longitudinal fissure, thicker than the left lobe, presents behind an *impressio renalis*, to which is applied the superior third or half of the right kidney, and before an *impressio colica*, for the *flexura coli dext.*, and sometimes the *duodenum*.

b b. Fossæ or fissures: 1. The transverse fossa, porta, *porta s. sinus venæ portæ (hilus hepatis)*, lies rather behind the centre, between the two longitudinal fossæ, and separates the *lobulus quadratus* from *l. Spigelii*; is fifteen to eighteen lines long and deep. It contains: *Vena portæ*, *Art. hepatica*, the roots of *ductus hepaticus*, numerous lymphatics, *plex. hepaticus* from *Nerv. sympathicæ*, surrounded by uniting tissue, *capsuli Glissonii*. Here commences also the *lig. gastro-hepaticum*.

2. The right longitudinal fossa:

a. Anterior half, *fossa vesicæ felleæ*, lies between *lobus dexter* and *quadratus*; is not deep, and does not reach so far as the anterior border of the liver; receives the gall bladder.

b. Posterior half, *fossa ven. cavæ*, is sometimes closed in the form of a canal; it contains the inferior *Ven. cava*, into which the hepatic veins open.

3. The left longitudinal fissure:

a. Anterior half, *fossa umbilicalis*, is sometimes closed up like a canal, lies between *lobus sinister* and *quadratus*, and contains: the umbilical vein of the Embryo (that is, *lig. teres*, after birth).

b. Posterior half, *fossa ductus venosi*, between *lobus sinister* and *Spigelii*; containing in the embryo the *ductus venosus Arantii*, which, connected with the umbilical cord and the left branch of the *ven. portæ*, the blood of which it carries into the *vena cava inf.*, sinks behind *lob. Spigelii* into *Ven. cava inferior*. It is obliterated after birth.

c. The Borders. 1. The anterior border is thin, sharp, oblique from below upwards, and directed from right to left; it presents to the left a deep incision, *incisura interlobularis*, where *lig. teres (V. umbilicalis)* lies; farther to the right a notch, at which point the *fundus vesicæ felleæ* is seen; it projects under the cartilages of the seventh to the tenth ribs into the *epigastrium*.

2. The posterior border is short and obtuse, rounded, attached to the diaphragm, being connected by uniting tissue; to it the *lig. coronar. hepatis* attaches itself from the diaphragm above and underneath. To the left a deeper notch, for *Ven. cava. infer.*; to the right, for *ductus venosus Arantii*. The right extremity of the liver is smooth, rounded, massive (with *lig. triangular. dexter.*); the left extremity terminates in an angular or obtuse process (with *lig. triangular. sinistrum*).

Structure. The proper substance (Parenchyma) of the liver is reddish or yellow; in other persons, darker (of a clouded colour, between olive green and chamois); close and lacerable. It divides into lobes, lobules, and gland granules, *acini*; these are accumulations of closed, yellow, nucleated cells, two to three lines long, half a line thick. The acini are seated like vine leaves upon pedicles, which are ramifications of the *vena hepatica*, which spreads itself out in their axis like the veins of a leaf. The surface of the *acini* is surrounded by a capillary network of the most delicate branches of *vena portæ*, which are in connection with *ven. hepatica*. From the blood of the *ven. portæ* the elements of the bile pass, probably, into the closed nucleated cells; but the connection of these with the biliary passages (ducts) has hitherto remained unexplained. The ducts are best considered, with Henle, as intercellular passages, which at first appear between the *acini*. The lobes and lobules are connected by uniting tissue, which enters in from the surface. The particular elements of the liver are:

Membranes: 1. The serous covering (*Peritonæum*) of the liver covers it as far as that part of the posterior border which is attached to the diaphragm, and to the floor of the grooves. From it the following folds pass off: *lig. coronarium* and *suspensorium*, *lig. hepatico-gastricum*, *duodenale*, and *renale*.

2. A fibrous investment covers the entire liver; is connected on its external surface with the serous coat; in the interior, with the parenchyma. It shows itself most distinctly in the porta, where it forms sheaths for the vessels, that is, *Capsula Glissonii*, and cells for the lobes and lobules, since prolongations extend from it into the interior of the organ.

Vessels: 1. *Vena portæ* forms a trunk in the *Porta*, from which, after the manner of arteries, right and left branches pass off, which ramify through all parts of the interior of the liver, dividing at acute angles, but not dichotomously, in a transverse direction, and are surrounded by sheaths of the *Capsula Glissonii*. Its capillary rete surrounds the *acini*, and passes over into the commencement of the hepatic veins.

2. *Art. hepatica*, a (small) branch of *art. cæliaca*, passes with the portal vein and the biliary canals. Its capillary rete spreads out upon the parietes of the vessels and biliary ducts almost exclusively, and unites with the rete of the portal vein.

3. *Venæ hepaticæ*, which arise in all points of the liver as *Venulæ centrales*, pass (in opposite directions from the lobes 1, 2, and 4) backwards towards *Ven. cava. infer.*, to which they convey the blood from the portal vein, and from *Art. hepatica*. (They are without sheaths, and therefore remain patent when divided transversely.)

4. The biliary passages, *ductus biliferi*, are narrow canals, which terminate in a cul-de sac (?), spreading, like the branches of a tree, through the liver,

are surrounded by a network of the capillaries of the *ven. portæ* and *hepatic* artery, and pass together into two large ducts (which, coming from the right and left hepatic lobes, and covered in the *porta* by sheaths of the *Capsula Glissonii*, unite together). According to E. H. Weber's latest researches, they form, like the blood-vessels, an uninterrupted and just as close rete, the interspaces being filled up with the vessels, so that the two together produce the hepatic parenchyma; in the *porta*, blindly ending *vasa aberrantia* of the liver are present.

5. Lymphatics: very numerous; first discovered in the liver; they open, partly, directly into the *ductus thoracicus*.

Nerves: 1. Branches of Vagus. 2. *Plexus hepaticus N. sympath.*

446. Apparatus for the excretion of the Bile.

a. The bile duct, *ductus hepaticus s. excretorius hepatis*,

arises by the association of the two biliary ducts before mentioned, is from one to one inch and a half long, and from two to two and a half lines thick. It passes out from the *Porta* behind the right branch of Art. Hepatica, passes downwards and backwards in the *lig. gastro-hepatic.*, and divides into two ducts, one of which, the left, *ductus cysticus*, leads into the gall bladder, the right, *ductus choledochus*, into the *Duodenum*. Situation: to the right of *art. hepatic.*, to the left of *ductus cysticus*; before *ven. portæ*.

447. b. The gall-bladder *cystis s. vesica fellea*, is a pear-shaped sac, three to four inches long, situated on the inferior surface of the liver, in the *fossa cystica*, it extends obliquely from before backwards, from below upwards, and from right to left, contains about eight to nine drachms.

We distinguish:

a. The *fundus*, the closed globular extremity which projects at the anterior border of the liver, touching, in that place, the abdominal walls (to the outer border of *m. rectus*, close to the anterior extremity of the tenth rib). Behind, the fundus of the gall bladder passes into the conical.

b. Body, *corpus*. This rests below upon the *pars super. duodeni* and the right extremity of the *colon. transv.* (not uncommonly also upon the *right kidney* or upon the *pylorus*). Above it is attached by loose uniting tissue to the liver.

c. The neck, *collum*, is twisted like a screw. It lies, generally, to the left, and passes under the *Porta* into the *ductus cysticus*, at which point a contraction marks the limit between them, as occurs, also, at its junction with the body.

Membranes. 1. A serous membrane (*Peritonæum*) covers the inferior surface, only, of the gall bladder.

2. A fibrous (muscular) coat, consisting of an internal stronger layer of longitudinal fibres, and an external of circular, similar to that of the vessels, is united with the serous by areolar tissue, is little extensible, and connected with the muscular coat of the intestinal canal.

3. Mucous membrane, villous, with short irregularly crossing folds (like a net), beset with *villi*, greyish white, coloured yellow by the bile, presents at the neck (where externally we remark the screw-like appearance) two small valves, but which assist neither the entrance nor the exit of the bile. (The space between the two is sometimes expanded like a sac, where gall-stones then form.) The internal surface is covered with cylindrical Epithelium.

Vessels: *Art. cystica* from *ram. dext. art. hepatica*. *Ven. cystica* passes into the right branch of *Ven. portæ*. Lymphatics: very numerous, sometimes coloured yellow, pass into *plex. portarum* and *gland. cæliacæ*. Nerves: from plexus hepaticus.

Function: The gall bladder preserves the bile brought to it through *ductus hepaticus* and *cysticus* for a time, and is again emptied through *ductus cysticus* and *choledochus*.

Bile (see 10).

448. c. The duct of the gall-bladder, *ductus cysticus*, the continuation of the neck of the gall bladder, from which it passes downwards and to the left, is thinner and shorter than the hepatic duct, passes downwards upon the right side of *ductus hepaticus*, and unites with this at a very acute angle in the *d. choledochus*. Situation: in the *lig. hepatico-duodenale*, before *ven. cava inferior*, to the right of *art. cystica*.

449. d. The common bile duct, *ductus communis choledochus*, formed by the united *ductus cysticus* and *hepaticus*, passes in the same direction as the last, obliquely downwards, rather backwards and to the right, has a thickness equal to a moderate goose-quill, and a length of from two to two inches and a half. At the superior part it lies in the *lig. hepatico-duodenale*, before *ven. portæ*, below *art. hepatica*, along the right side of *art. gastro-epiploica dextra*, surrounded by uniting tissue and lymphatic glands; then behind and on the internal border of the *pars descend. duodeni* in a groove on the head of the *Pancreas*; lastly, it perforates very obliquely the muscular coat of *pars descend. duodeni* at its centre, passes six or seven lines between the muscular and mucous coat, on the right side of *duct. pancreaticus*, perforates the mucous membrane on the internal wall of the inferior portion of the *pars desc. duodeni* with a round opening (so that a retrograde course of the bile, &c., is impossible), after having received, shortly before, the *duct. pancreatic.*

Structure. It is like the duct of the gall bladder.

450. 2. Abdominal salivary gland, *Pancreas*.

This is a long, flat, greyish white gland, which is placed transversely behind the greater curvature of the stomach, before the twelfth dorsal and first lumbar vertebra, and extends from the concavity of the duodenum as far as the spleen. In length: seven to eight inches; thickness: half to one inch; breadth: one and a half to two inches and three quarters; weight: three to four ounces. The right extremity (*caput, extremitas duodenalis*), thick and broad, lies coiled in the curvature of the *duodenum* (and on the *ductus choledochus*); partly before the *P. horizontalis inferior duodeni*, close before the *art. and ven. mesenterica, aorta* and *v. cava infer.*; it is called, when separated from the rest, *Pancreas parvum Winslowii*.

The left, splenic extremity (*cauda*) is narrow, and lies on the internal surface of the spleen.

The superior thick border has a groove for *art. lienalis*, and looks towards the *pars super. duodeni, lobul. Spigelii* and *art. cœliaca*. The inferior border lies along the *p. horizontalis duodeni infer.*, separated to the left by *art. and ven. mesenterica superior*.

The anterior convex surface, covered by the peritonæum, looks towards the posterior wall of the stomach, the commencement of the *duodenum* and the *flexur. coli dextra*.

The posterior concave surface is not covered by peritonæum; separated from the vertebræ by *V. lienalis, mesenterica superior*, and commencement of *Ven. portæ*, cruræ of the diaphragm, *V. cava inf.* (on the right), *Aorta* (to the left). To the left of the vertebral column it rests upon the *caps. supra renales, renal vessels* and nerves. The *Pancreas* follows the movements of the *Duodenum*.

The excretory duct, *duct. pancreaticus* seu *Wirsungianus*, arises in the splenic end, by the conjunction of several canaliculi which come from the lobules of the gland, always becoming wider, as all the canaliculi open directly into it, and passing in the central part of the gland to the right extremity, where it makes its exit, lying to the left of the *ductus choledochus*, which it perforates, and opens in common with it in the *pars descend. duodeni*. Its walls are very thin, extensible, milk-white, and inwardly smooth. Two pancreatic ducts are frequently present, one of which opens in an isolated manner into the *duodenum*.

Structure: The *Pancreas* consists, like the salivary glands, of conglomerated lobules connected together by uniting tissue, these again of vesicles (*acini*), in which the canaliculi commence.

Vessels: *Art et Ven.* are branches of *lienalis, pancreatico-duodenalis*, and *mesenterica superior*.

Nerves: They come from *plexus lienalis, gastricus, mesentericus superior*.

Function: Secretion and excretion of *succus pancreaticus* (that is, a colourless, transparent, and viscous mucus, in which we find soda, common salt, phosphate of lime).

451.

3. The Spleen, *lien, spleen*,

a spongy organ very rich in blood (blood gland) which lies deep in the *reg. hypochondr. sinistra*, behind and to the left of the *fundus* of the stomach, above the left kidney, in a fold of the peritonæum, and becomes displaced by the movements of the *diaphragm* and *stomach*. Figure: semi-oval (also prismatic). Colour: bluish or brownish red or even pale grey, by long exposure to the air, rosy red. Weight: two to eight ounces (in hypertrophy = ten to thirty pounds); specific grav.: 1·16. Length: four to five inches; breadth: two and a half to three and a half; thickness: one to one and two-thirds.

The external, convex, smooth surface, separated by the *diaphragm* from the ninth to the eleventh ribs, looks upwards and backwards.

The internal concave surface looks obliquely forwards towards the *Pancreas* and *fundus* of the *stomach*, and presents, in about the centre, a superficial oblong excavation, *hilus lienalis*, where the splenic vessels enter and pass out, and *lig. gastro-lienale* is attached. Before, the *hilus* is in contact with the *fundus* of the *stomach*; behind that, the left kidney and *caps. sup. renales* and the tail of the *Pancreas*.

The superior thick extremity lies under the *diaphragm*; the inferior pointed extremity rests upon the angle of the *colon (transv. and descend.)*. The borders are sometimes deeply indented, and thus present traces of a second spleen (*lien. succenturiatus*) or several, which in the *fœtus* and children are frequently observed. The posterior border, thick above, is adjacent to the kidney, the anterior is applied to the stomach.

Structure: 1. The proper substance of the spleen is a pultaceous, reddish brown, granular mass, *pulpa lienis*, which consists of pencillate tufts of capillary vessels, out of which veins pass, and which lies like a sponge in the whitish cells of a fibrous membrane.

2. The fibrous coat, *tunica albuginea*, forms the frame-work of the organ, since it covers it externally, and sends prolongations into the Parenchyma, like a net, especially at the *hilus*, where it forms sheaths for the vessels, and accompanies their ramifications, so that the whole acquires a spongy structure.

White splenic corpuscles, *corpuscula lienis Malpighi* (not to be confounded with the liquefying vesicles of *Herbivora*), lie, according to J. Müller, inside the red granules of the *pulpa*, and are seated upon the white sheaths of the arterial branches, of which they are merely sprouts (according to Heusinger *blastema*, formative matter).

3. The serous tunic (peritonæum) envelopes the whole spleen, even to the *Hilus*, where the *lig. gastro-lienale* comes over from the *fundus* of the stomach. *Lig. phrenico-lienale* goes from the superior extremity of the spleen to the posterior portion of the inferior surface of the *diaphragm*. Its internal surface is firmly connected to the external of *t. albuginea*.

4. Vessels: a. *Art. lienalis*, branches of *cœliaca*, divides into four or five twigs, each of which supplies one or the other independent parts of the spleen. b. *Ven. lienalis*, the principal branch of the *ven. portæ*, four or five times larger than the *Art.*, without valves. c. Lymphatics: they go into the glands along the *hilus*, between the layers of *lig. gastro-lienale*.

5. Nerves: come immediately from *plex. lienalis*, as well as from *pl. solaris*.

Function: The preservation or alteration of the blood or the lymph (?), according to Cruveilhier, makes up the chief substance of the spleen, as that terminates in cells.

452.

The *Peritonæum*,

is a serous, (in the male) entirely closed sack, (in the female open at the extremities of the Fallopian tubes,) which on the one hand lines the abdominal walls, on the other partially invests the organs which lie within them. These last are the organs of digestion (below the diaphragm) and the female organs of generation. But they do not lie within the cavity of the sac, but in folds on the external surface of it. Quite unfolded, the sac would present the appearance of a bladder, divided into a larger and smaller (by a constriction), but which are connected together by an opening at the place of constriction, and of which, the smaller (*saccus epiploicus*, because it forms the omentum, *epiploa*) is inverted into the larger. The place of constriction surrounds a semicircular (or triangular) space (*foramen Winslowii*), one inch in size, which is bounded before by the gall-ducts, behind by *ven. cava infer.*, below by *duodenum*, above by the neck of the gall bladder, and is situated under the *lobulus Spigelii*. As the peritonæum passes upon the organs contained in the abdominal cavity there become formed: 1. Folds (ligaments), e. g., such as lie between two different viscera. 2. Mesenteries; these are inversions from the posterior abdominal walls which always consist of two layers. 3. Omenta; these are prolongations of laminæ over the organs.

As the peritonæum forms a closed sac, the description of it may be commenced at any point.

453.

A. *Peritonæum abdominale*.

The walls of the abdominal cavity are lined all round by the peritonæum as with a sac, with the exception of those places on the dorsal wall, at which inversions take place into the interior of this sac, for the purpose of surrounding the viscera with a particular envelope (compare *Pleura*), and thus to form the *Peritonæum viscerale*. The internal surface of this parietal layer looks into the cavity of the sac, is smooth and slippery like the visceral layer, which is turned to it. The external surface is rough, loosely attached by uniting tissue to the internal surface of

the walls of the abdominal cavity. It is, according to the walls, divided into :

1. Anterior wall, formed by the abdominal muscles. It covers the whole posterior surface of the anterior and lateral abdominal muscles, separated from it by *fasciæ rectæ* and *transversal*. Of it four folds pass off from the umbilicus.

a. *Ligam. suspensorium hepatis*, the so-called suspensory ligament of the liver, upwards, which surrounds the *lig. teres* (the obliterated *ven. umbilicalis*) at the sides and behind, and goes to the liver.

b. *Lig. suspensorium vesicæ* s. *Plica urachi* passes downwards in the middle line from the umbilicus, on the obliterated *Urachus* to the superior border of the urinary bladder.

c. *Plicæ pubo-umbilicales*, two lateral folds from the umbilicus to the *ligg. lateralia vesicæ*.

Between these folds two recesses arise behind and above the femoral arch (Poupart's Ligament) on either side of the middle line, the external of which is again divided by the obliquely ascending but little projecting *vasa epigastrica*. On each side we therefore observe :

a. *Fovea inguinalis interna* between *symphysis pubis* and *ven. iliaca* (in the crural ring) behind *lig. Gimbernati*.

b. *Fovea inguinalis media* between the sides of the *lig. later. Vesicæ* and *v. epigastr.* turned towards one another, above and behind the crural ring (important in *crural* as well as in *direct inguinal hernia*).

c. *Fovea inguinalis externa*, on the external side of *vasa epigastrica* (important in *oblique inguinal hernia*).

NOTE.—b. and c. are together distinguished as *fossa inguinalis externa*.

2. The inferior or pelvic wall descends from the above described folds, and the posterior surface of the *ossa pubis* backwards, into the small pelvis over the superior and posterior surfaces of the urinary bladder, covers, in the female, the *uterus* and the anterior surface of the *rectum*; in the male, immediately, the last. Here it forms between bladder and uterus, which, together with its *tubes*, *ligg. rotunda* and both the *ovaries*, it receives in a broad fold, a *fossa (excavatio vesico-uterina)*, the two broad ligaments (*ligg. lata*), and *ala vespertilionis*; between *Uterus* and *Rectum* the *excavatio recto-uterina*, between the two *plicæ Douglassii*, which last, in the male, are situated between the bladder and rectum. Into the *fossæ* the convolutions of the small intestines descend. Hence the peritonæum ascends to the dorsal wall, as :

3. The posterior wall, situated before the *mm. quadrati lumborum*, the *Kidneys*, *Ureters*, *Aorta* and *ven. cava*, *nn. sympathici*, *vv. azygos*, *hemiazygos* and *duct. thoracicus*, and forms, hence, the inversions or reflections for the viscera (*periton. viscerales*), the access to which is concealed by uniting tissue.

4. The superior wall covers the inferior surface of the diaphragm, passing over behind upon the Liver, Stomach, and Spleen, before upon the anterior abdominal walls.

454.

B. Peritonæum viscerales,

the intestinal layer, consists of *two* large and several smaller inversions from the posterior walls. The superior larger invests the *Liver*, *Stomach*, *Spleen*, *Colon transversum*, covers the anterior surface of the *Duodenum* and *Pancreas*, and contains the

Omenta; the inferior larger envelopes the *Jejunum* and *Ileum*, and forms the mesentery (*mesentericum*); the smaller contain: *Cæcum*, *Colon ascendens* and *descendens* and *rectum*, and form their mesenteries.

455. Route, or course, of the *Visceral* layer.

[Reflections of the *Peritonæum Viscerale*.]

1. From the inferior part of the *pars tendinea* of the diaphragm, the *Peritonæum* passes to the obtuse posterior border of the liver, and forms *Lig. coronarium hepatis*, the right and left extremity of which is considered as *Lig. triangulare dextrum* and *sinistrum*; continues to the superior extremity of the spleen, and forms: *Lig. phrenico-lienale*; lastly, to the *cardia* of the stomach, forming a right and left *lig. phrenico-gastricum* on the sides of the *cardia*.

456. 2. From these places the *Peritonæum* passes:

- a. over the superior surface of the liver to the inferior surface covering it entirely, with the exception of *lobulus Spigelii*.
- b. over the anterior wall of the Stomach as far as the great curvature.
- c. over the whole Spleen, except its *hilus*; forming between its internal surface and the fundus of the Stomach the *lig. gastro-lienale*, the posterior layer of which passes from *sacc. epiploicus*.

457. 3. The *Peritonæum* afterwards proceeds:

- a. from the right portion of *porta hepatis* to the right kidney and the angle of the *Colon ascendens* (forms *lig. hepatico-renale* s. *colicum* at the right border of *foram. Winslowii*).

From the left anterior portion of the *Porta* (before *ven. portæ, vasa* and *duct. hepatic.* downwards) to the anterior wall of the *duodenum*, forming the *lig. hepatico-duodenale*.

From the *fossa ductus venosi* towards the left, to the smaller curvature of the stomach, forming the anterior layer of the small omentum, *omentum minus* s. *lig. hepatico-gastricum*.

This attaches itself with its inferior concave border to the small curvature of the stomach, with its superior to:—1. The *porta hepatis*. 2. The *æsophagus* and the diaphragm; bounded on the right by the *hepatic vessels* and *gall ducts* (behind them *foram. Winslowii*), to the left by the *æsophagus*.

- b. From the spleen on the right into the great omentum, on the left to the superior angle of the *colon descendens*.

c. From the stomach (over the anterior surface of the *colon transv.*) and behind the anterior abdominal walls, before the small intestines, downwards into the pelvis. Here it becomes reflected upon itself, and ascends to the Pancreas (Arnold. According to others it goes immediately upon the superior surface of *colon. transv.*), [covering the posterior surface of the transverse arch of the colon, and forming the post. layer of mesocolon trans.], and thus forms the first [anterior] and fourth [posterior] layer of the great omentum.

Omentum (s. *epiploon*) *majus*, the great omentum, reaches in adults as low as the femoral arch, is transparent and thin, in fat persons much beset with

adipose tissue, particularly around the vessels. It consists of four layers, the two internal of which are formed by the *saccus epiploicus*. Its vessels (from *artt.* and *vv. gastro-epiploica dextra* and *sinistra*) descend between the anterior layers and ascend again between the posterior, anastomosing with those of *colon transv.* Lymphatic glands on the curvature of the stomach and the colon. Nerves from *plex. solaris*, along with the arteries.

Saccus epiploicus, the omental sac, is formed as the peritonæum passes through the *foram. Winslowii* from right to left, above the *lobulus Spigelii* [to the transv. fissure of the liver, hence] to the lesser curvature (as posterior layer of small omentum), on the posterior surface of the stomach, downwards behind the anterior layer of the great omentum, becomes reflected [backwards] upon itself and ascends, before the posterior layer, covering the anterior surface of the Pancreas, and superior third of Duodenum [in front of the anterior surface of the transv. colon, and forming the ant. layer of trans. mesocolon], and inclining to the right it passes out at the foramen of Winslow, [after ascending upon the crura of the diaphragm, being reflected upon and covering the *lobulus Spigelii*, and entering the transverse fissure of the liver].

458. 4. The Peritonæum forming the fourth layer [posterior] of the great omentum was traced to the dorsal wall below the Pancreas. Hence it again passes downwards and forwards, thus forming the two layers of which *mesocolon transv.* consists, and which lie transversely between *jejunum* and *ileum*,—liver, stomach, and spleen.

459. 5. Turning back (as inferior [posterior] layer of *mesocolon transv.*), it passes again downwards before the second and third abdominal vertebræ [and the transverse third of the *duodenum*] surrounding the numerous convolutions of the jejunum and ileum, and again turning back to the vertebral column (as it forms the root of the *mesenterium*), it thence descends to the inferior (pelvic) wall before the rectum, &c.

Mesenterium. The mesentery consists of two curly-folded laminæ which lie close to one another, pass down, vertically, on the left side of the vertebral column [obliquely from the left side of the body of second lumbar vertebra to the right sacro-iliac synchondrosis], receive between them the branches of *art.* and *ven. mesenterica superior*, Chyle vessels and Lymphatic glands (*gl. mesaraicæ*), and at the concave surface of the small intestines separate from one another, for the purpose of enclosing these organs.

To the right, left, and below, we find, besides this large inferior inversion, several smaller, which proceed from the dorsal wall and pass into the parts described. They are the incomplete mesenteries for the *colon ascendens* and *descendens* for the *cæcum* and *sigmoid flexure*, and for the *rectum* (*mesorectum*).

460. The organs of Respiration, *Organa respirationis*, are the lungs, the thorax, the trachea, the larynx and pharynx, and the nasal cavities.

461. 1. The Larynx, *larynx s. organon vocis*, the most superior portion of the trachea, is a moveable canal formed of seven cartilages, in the centre of the anterior superior region of the neck, under the *os hyoides*, before the inferior part of the pharynx (between fourth and sixth vert.).

Shape: above, broader and three-cornered; below, narrow and cylindrical.

Elements: cartilage, ligaments, muscles.

a. Cartilages of the Larynx: *Thyroid* and *Cricoid* are true, the rest, fibro-cartilages.

462. 1. Thyroid cartilage, *cartilago thyreoidea*, occupies the greatest part of the anterior and lateral walls, and consists of two oblong four-sided plates, which are united at an acute angle, in the middle line, and the surfaces of which are directed obliquely backwards and outwards. External surface. In the male the angle projects more strongly forwards (Adam's apple) than in the female, and before puberty, when it is more rounded. At the posterior part of the external surface of each lateral plate we find above, a tubercle, and below, a larger; between the two we perceive a *linea obliqua*, before which *m. thyro-hyoideus* and behind which *mm. constrictor infer.* and *sterno-thyreoid.* are situated; sometimes a foramen for *Art. laryngea super.* Internal surface: a. At the angle are attached the *vocal cords* and *mm. thyro-arytenoid.* b. The sides project out over the *cricoid cartilage*. The superior border is twisted, in the centre deeply excised, *incisura thyreoidea*, it looks towards the *hyoid bone* and terminates at the sides with the *great cornua*. Here is attached *Membr. hyo-thyreoid*. The inferior border, shorter than the last, inclines towards the *cricoid cartilage*, serving for the attachment of *m. crico-thyreoid.*, in the centre the *lig. crico-thyreoid.*; is bounded externally by the *lesser cornua*. The posterior border, slightly twisted, serves for the attachment of *mm. stylo-pharyngeus* and *pharyngo-staphylinus*, leans on the vertebral column. The horns, *cornua*, are oval elongations of the posterior borders, directed inwards and backwards. The larger *superior* are in connection with the *hyoid bone* by ligaments, the less *inferior* with the *cricoid cartilage*.

2. The annular cartilage, *cartil. cricoidea*, thicker and more solid than the other cartilages of the *larynx*, is circular, narrow before, broad behind (one inch) and like an escutcheon, four-cornered. External surface. In front in the centre under the skin; serves laterally for the attachment of *mm. crico-thyreoid.*, presents an articular process for the *thyroid cartilage*; behind, in the centre a projection for muscular fibres of the pharynx; laterally, a depression for *m. crico-arytenoid. posterior*.

The internal surface is covered with mucous membrane. The inferior border is completely circular, connected with the trachea by *lig. crico-tracheale*. The superior border is irregular, before low, with two articular surfaces (for the *arytenoid cartilages*), behind (on the shield) placed higher. The shield forms the inferior half of the posterior wall of the *larynx*.

3. The arytenoid cartilages, *cartilagine arytenoidæ s. pyramidales* are two moveable cartilages, standing close to one another, vertically, upon the shield of the *cricoid*, and forming the superior part of the posterior wall of the *larynx*. Below broad, above pointed, the anterior surface convex, narrow, grooved, with the superior vocal cord; the posterior surface concave and broad (for *m.*

arytænoideus). Basis, articulated with the *cricoid. cartilage*, with the posterior external tubercle (for *m. crico-arytænoïd. later. and posticus*) and an anterior (for the inferior vocal cord). Apex with articular surface for the *cornicula Santorini*.

4. *Cartilagg. s. cornicula Santorini*, two small round and three-cornered cartilages upon the apex of the *arytænoïd. Cart. Wrisbergii*, small cartilages sometimes present in the *ligg. ary-epiglottic.* between *epiglottis* and *cartt. Santorini* (in some animals more abundant).

5. The *epiglottis*, a thin, elastic, and yellow fibro-cartilaginous plate behind the root of the tongue and before the entrance to the *Larynx*, is three-cornered, heart-shaped, and curved like a saddle; stands upright, directed rather backwards; is applied, in swallowing, horizontally over the entrance to the larynx, and is broader than it. The anterior surface is above and below concave, in the centre convex, above free and projecting over the root of the tongue, it lies below, behind the root of the tongue, the *os hyoides* and the *thyroid cartilage* (with the strong *lig. glosso-epiglotticum medium*, containing muscular fibres, the *hyo-epiglotticum* and *gland. epiglottica*, that is, fat, between *epiglottis* and *thyroid cartilage*). The posterior surface is quite free, looks into the larynx, is covered with mucous membrane and perforated by numerous glandular openings (*gland. epiglotticæ*). In the centre it is concave. The superior border is broad (Basis) slightly sloping, and passes with rounded angles into the lateral borders, from which on either side two folds (*plica arytæno-epiglott.* and *pharyngo-epiglottica*) go off, and to which the *reflector* is attached. The apex (pedicle) is attached to the superior angle of the *thyroid cartilage* (behind *pomum Adami*) directly over the vocal cords, the *lig. thyreo-epiglotticum*.

463. b. Connections of the Larynx:

1. With the *os hyoides*, by four ligaments:

a. *Lig. thyreo-hyoideum medium*, yellowish, broad, fills the space between the superior border of the *thyroid cartilage* and the *os hyoides*; is in the (thick) centre covered by the skin, on the sides by *m. thyreo-hyoid.*, lies before the *Epiglottis* (separated by fat) and the mucous membrane.

b. *Ligg. thyreo-hyoidea lateralia*, small and narrow, between the greater (superior) *cornua* of the *thyroid cartilage* and those of the *os hyoides*. A Synovial capsule lies between the posterior surface of the *corp. oss. hyoid.* and the superior of the *thyroid cartilage*.

c. *Lig. hyo-epiglotticum*, between the anterior surface of the *epiglottis* and the posterior border of the *os hyoides*.

2. With the Trachea by *lig. crico-tracheale*, that is, a small fibrous band which strengthens the membrane (on the anterior surface) between the *cricoid cartilage* and the rings of the *Trachea*.

3. Connection of the Laryngeal cartilages with one another:

a. *Lig. crico-thyreoideum medium s. conoideum*, yellow, thick, broad, triangular, the apex at the inferior border of the thyroid, the basis at the superior border of the *cricoid cartilage* (before).

b. *Ligg. crico-thyreoidea lateralia*, strong, laterally from the bend of the *cricoid* [inner lip of upper border] to the inferior *cornua* of the *thyroid cartilage* [retreating angle of Thyroid cartilage], horizontally below the inferior vocal cord.

[Articulation between the *lesser cornua* of the *thyroid cartilage* and the

surfaces on the sides of the *Cricoid*—surfaces plane. Ligament, capsular with shining parallel fibres—synovial capsule. The crico-thyroid articulations are all Arthodial. TRANS.]

c. *Ligg. crico-arytænoidea* unite the *arytænoid* cartilages with the plate of the *cricoid*, at the posterior internal surface; strong but loose. [Synovial capsule.] The *arytænoid* cartilages are moveable in all directions, but especially outwards and inwards.

d. *Ligg. aryteno-epiglotticum*, inside the folds of mucous membrane from the anterior surface of the *arytænoid* cartilages to the borders of the *epiglottis*.

4. Vocal cords, *ligg. vocalia* s. *glottidis*, s. *thyreo-arytænoidea*, are four ligaments which extend between the angle of the *thyroid* (on the posterior surface) and the anterior surface of the *arytænoid* cartilages, passing from before to behind through the midst of the cavity of the larynx. There are, right and left, a superior and an inferior. The triangular fissure between those on the right and those on the left side is called the *glottis* s. *rima glottidis*, is before narrow, behind roundish, at that part formed by *cartil. cricoid*, and *cartil. arytenoid*, and is not capable of being completely closed (Mayer).

a. *Ligg. vocalia inferiora*, are thick roundish cords attached before to the angle of the *thyroid*, behind to the anterior tubercle of the *arytænoid* cartilages; covered externally by *m. thyro-arytænoideus*, internally by closely-applied mucous membrane, they meet below at the *ligg. crico-thyroid. lateralia*.

b. *Ligg. vocalia superiora*, less strong than the last, above them in the middle of the larynx, under the *Epiglottis*, not quite horizontal. Below them the mucous membrane forms a sac, *ventriculus Morgagni*; above they meet in *lig. aryteno-epiglotticum*.

464. C. The muscles of the Larynx. The whole larynx is moveable: *Mm. sterno-, omo-, thyreo-hyoidei, sterno-thyreoidi, &c.* (see before); the separate cartilages are moved by the following muscles:

1. *Crico-thyreoidi*, two short, thick, triangular muscles on the anterior surface of the larynx, behind *m. sterno-thyreoid* and thyroid gland, in contact below with the last, above *m. crico-arytænoid. later*; the internal borders separated by a quadrangular space. Or.: the anterior surface of the *cricoid* cartilage. Ins.: the inferior border and internal surface, and the anterior border of the *inferior Cornua* of the thyroid cartilage. Use: to approximate the *cricoid* and *thyroid* cartilages, elongating the *glottis* and stretching the vocal cords.

2. *Crico-arytænoidi postici*, triangular, on the posterior surface of the *cricoid*, covered before by this, behind by the mucous membrane of the *Pharynx*. Or.: from the posterior surface of the *cricoid* cartil. Ins.: external angle of *basis cartil. aryten.* Use: to separate the two vocal cords of either side from one another, widening the posterior part of the *rima glottidis*.

3. *Crico-arytænoidi laterales*, two flat, rhomboidal-shaped muscles. Situation: on the posterior wall of the *Larynx* (internal surface), oblique upwards and backwards; closely connected internally with *thyreo-arytæn.* Or.: the lateral part of the superior border of the *cricoid* cartilage. Ins.: external angle of the *arytænoid* cartilages. Use.: to draw the external angles of the *arytænoid* cartilages forwards; the anterior angles with the vocal cords pass inwards, and thus contract the *rima glottidis*.

4. *Thyreo-arytænoidæi*, two thin, longish processes of the last muscle. Situation: between *thyroid* cartilage and mucous membrane of the internal surface of the *Larynx*, chiefly in the fold of the vocal cords. Or.: the angle (inferior two thirds) of the *thyroid* cartilage. Ins.: the anterior angle of, the external border of the *arytænoid* cartilages. Use: to draw the *cartil. arytenoid.* forwards, and shorten the *rima glottidis*; extending at the same time the vocal cords.

5. *Arytænoidæus*, short, thick, rhomboidal, lying in the concave posterior surfaces of the *arytænoid* cartilages, and in the space which divides them; consists of a deep transverse layer, that is, *aryt. transversus*, and two crossing each other obliquely, *arytænoidæi obliqui*. The inferior border touches the *cricoid* cartilage; upon the superior lie glands, and a fold of mucous membrane which separates the *introitus laryng.* from the *Pharynx*. Points of attachment: the external angle and the posterior concave surface of *cartt. arytenoidæa*. Use: to approximate the *arytænoid* cartilages, and thus contract the posterior part of the *rima glottidis*.

6. *Reflector epiglottidis* (Theile); in the fold of mucous membrane from the lateral borders of the *epiglottis* to the *cartill. arytenoid.* and *Santorini* of either side. Or.: from three places. 1. Posterior portion from the external angle of *cartil. arytenoid.* of the other side, crosses obliquely. 2. Central portion, from the attachment of the superior vocal cords to the *arytænoid* cartilages. 3. Anterior portion, from the internal surface of the *thyroid* cart. Ins.: lateral border of the *epiglottis*. Use: bends the *epiglottis* backwards, closing (and contracting) the entrance to the *larynx*.

c. The mucous membrane of the *larynx*, a continuation of that of the mouth and nose, passes from the root of the tongue upon the anterior surface of the *Epiglottis*, as it forms three folds (*ligg. glosso-epiglottica*), then covers the posterior surface and passes from its borders upon the *cartil. arytenoid.*, and from these upon the posterior surface of the *larynx* (where this forms a portion of the anterior wall of the *Pharynx*). At the lateral parts of the entrance to the *larynx*, above the *rima glottidis*, the mucous membrane forms two folds (*ligg. ary-epiglottica*), covers the superior vocal cords, is loosely suspended in the pocket-like hollows which the *ventriculi Morgagni* form, but firmly and thin to the inferior vocal cords, from which it passes over upon the internal surface of the *cricoid* cartilage, the *memb. crico-thyroid* and the *Trachea*.

The mucous membrane is very thin, pale red, very sensitive (particularly over the *rima glottidis*), and contains in the *ligg. ary-epiglottica* much (serous) uniting tissue.

d. Glands: 1. *Gland. epiglotticæ*, small, numerous, under the mucous membrane, on the posterior surface of the *larynx*; they open towards the sides of the *larynx*.

2. *Gl. arytenoidea* (*Morgagni*), lie in the *Plica (ligam.) ary-epiglottica* in the shape of letter L, opening into the *larynx*. The vertical portion lies on the anterior surface of the *arytænoid* cartilages, the horizontal on the superior vocal cord.

e. Vessels: *Artt. and Ven. laryngea super. and infer.* (from *thyroid super. and infer.*). Lymphatics pass into the glands above the hyoid bone (in the neck).

f. Nerves: *N. laryngeus superior* and *laryng. inferior* (s. *recurrens*) from *n. vagus*.

465. The Thyroid Gland, *Glandula thyreoidea*,

a blood gland on the anterior part of the neck, between the inferior half of the *thyroid* cartilage and the superior rings of the *trachea*, lying in the shape of a crescent with the horns directed upwards, varying in circumference (in the female larger than in the male), and weight one ounce or more, heavy; of a bluish, in the embryo more of a bright red, colour; consists of two lobes, *lobi*, *cornua*, and a central, inferior, and flat portion, *isthmus*, from which frequently a third lobe, *cornu medium*, ascends as far as *incisura thyreoidea*. But the *isthmus* is also, frequently, so small, that it appears to be entirely wanting; or it reaches down as far as the *sternum*. The *isthmus* is before convex, and separated from the skin by *mm. sterno-hyoid.* and *thyroideus* and *fascia colli*; behind concave, and lying before the rings of the *trachea*. The lateral lobes are before convex and covered by the *m. sterno-thyroid*; internally concave, and surrounding the inferior part of the *thyroid* cartilage, the lateral portion of the *trachea*, the inferior of the *pharynx*, and the superior of the *œsophagus*; they are in relation with, behind, the vertebral column (separated from it by *Art. carotis commun.*, *V. jugular int. n. vagus* and *sympathicus*). The apex of the *cornu* lies on the outer side of *Art. carotis*, on the outer and posterior of the *thyroid* cartilage, and sometimes reaches as far as its superior border. The inferior extremity, thick and round, lies before the fifth and seventh *tracheal* rings, between the *trachea* and the *carotis commun.*; here the *Art. thyroide. infer.* enters the inferior convex border of the gland; at the superior concave border the *art. thyroide. superior* occurs.

The Parenchyma of the *Thyroid* gland consists of a spongy uniting tissue, the cells of which are connected by openings with each other, without possessing any excretory duct; perforated by many vessels it contains a yellowish white serum, the destination of which is not known. Externally the *thyroid* gland is invested by a dense uniting tissue which is strengthened by *fasc. cervicalis*, *M. thyroideus* (see before).

Vessels: *Artt. thyroide. super.* (from *A. carotis*) and *inferior* (from *subclavia*), *Vv. thyroide sup. and med.* (in *V. jugular intern.*), *inferior* (in *V. anonyma*).

Nerves: *N. laryngeus super. and infer.* (from *N. Vagus*), and branches of *gangl. cervic. med.* or *infimum* of *N. sympathicus*.

466. 2. The Windpipe, *Trachea, arteria aspera*,

is a moveable tube composed of cartilages and membranes, four or five inches long, which, close under the *cricoid* cartilage, extends from the fifth cervical as low as the third dorsal vertebra, in which region it divides into its two branches, *bronchi*. In

front and at the sides cylindrical, it is formed of from seventeen to twenty cartilages placed one above the other, and of the shape of the letter Ω ; behind, flat and membranous.

Cervical portion. 1. Before and above, covered by *isthmus gl. thyreoid.*, *mm. sterno-thyreoides* and *fasc. cervicalis*, below by much uniting tissue (*Art. thyreoidea*), and a little by *Art. anonyma*. 2. At the sides: *Gl. thyreoidea*, *A. carotis comm.*, *n. vagus*, lymphatic glands. 3. On the posterior surface: *æso-phagus* (which projects rather to the left), *n. recurrens dexter* and *sinister* (which passes towards the left side).

Dorsal portion, in the *mediastinum posticum*. Before it lie, from above downwards: *Sternum* and *m. sterno-thyreoid*, *V. subclavia sinist.* and *truncus anonymus*, the posterior portion of *Arcus Aortæ* and *Art. pulmonalis* (bifurcation); behind it: *Æso-phagus*; on the sides: *Pleura*, *Nn. vagus* and *recurrens* (superior part); a quantity of uniting tissue and lymphatic glands.

The *Bronchi* are the two branches of the *trachea*, into which it divides before the third dorsal vertebra. The obtuse angle of division (*bifurcation*) is filled up by a triangular ligament and the blackish bronchial glands. The *bronchus dexter*, one inch long, about eight lines thick, consists of five to six Ω shaped cartilaginous rings, divides into three branches with which it enters into the right lung, and lies close under the bend of *V. azygos*, behind *V. cava superior* and *Art. pulmonalis dextra*. *Bronchus sinister*,—two inches long, about five lines thick, consists of from ten to twelve Ω shaped cartilages, divides into two branches for the two lobes of the left lung, lies under the *arcus Aortæ* and obliquely before the *æso-phagus*, behind *Art. pulmonalis sinistra* and before *aorta descendens*. Between each *bronchus* and *Artt. pulmonales* we find the *Vv. pulmonales*. The branches of the bronchi again ramify and always dichotomously (*bronchia*) until at last they terminate in the pulmonary vesicles. Vessels: *Artt. bronchiæ* come from the *Aorta*; *Vv. bronch.* enter the *V. azygos* (upon the right side), the *v. intercost.* (upon the left).

Structure. 1. The cartilaginous rings are placed at tolerably equal intervals, horizontally above one another, the interspaces filled up with fibrous rings. Flexible and elastic in the young, they frequently ossify as age advances. Of unequal vertical diameter ($1\frac{1}{2}$ to $2\frac{1}{2}$ lines), several of them frequently unite together. The vertical diameter of the first is the greatest. The last, the longest, is turned downwards, has behind an acute angle where the first Bronchial rings pass off. 2. The fibrous membrane (*perichondrium*) commences at the inferior border of the cartilages to which it passes as *lig. crico-tracheale*, covers both surfaces of the cartilages, fills the interspaces, and assists (with the other membranes) to form the posterior flat wall of the *trachea* and *bronchi*, which is attached by uniting tissue to the *æso-phagus*. 3. Transverse, smooth muscular fasciculi, between the posterior extremities of the cartilages approximate these to one another. 4. Yellow, elastic bundles of fibres, pass parallel to the long axis on the internal surface of the muscular coat. 5. The mucous membrane is thin, paler than in the larynx, firmly attached (without folds), and perforated by numerous openings, which are the openings of small, flat, oval *glandul. tracheales*, which are situated between the mucous and muscular coats.

Vessels of the *Trachea*: 1. *Artt. tracheales* (from *thyreoid. infer.*) inferiores (from the *Aorta*). 2. The veins of the spaces between the cartilages open into the great trunks along the *trachea* (on the internal surface), and these into the *Vv. thyreoidæ infer., mammar.,* and *azygos*. 3. The Lymphatics, very numerous, pass into the great lymphatic glands at the bifurcation.

Nerves: *Nn. tracheal. superior.* (from *ram. recurrens Vagi*);—*inferiores* (of the trunk of *plexus pulmonalis* of *N. Vagus*).

467.

3. The Lungs, *Pulmones*,

are two soft bodies, between which lies the heart, and each of which fills up the lateral half of the cavity of the thorax; of an irregular, conical shape, internally deeply excavated, with the base directed downwards. Colour: in the adult and aged, greyish blue, traversed by dark blue vessels and bluish black spots, which form polygons, on which account the surface appears marbled; the posterior surface (generally) a reddish brown. As age advances, the black spots which lie in the interposed uniting tissue, increase. Weight: In the fœtus the lungs, in relation to the body, are as 1 : 60; in the adult, 1 : 30. Spec. grav. before birth and respiration: heavier than water; afterwards: lighter than water. In the male, the lungs are heavier ($3\frac{1}{2}$ pounds) than in the female ($2\frac{3}{4}$ pounds).

Each lung is invested by a serous membrane (*pleura*), and presents: 1. An external, convex surface, which is separated from the ribs by the *pleura* only, and by a deep fissure, *incisura interlobularis*, into two and three lobes (*lobi*). The fissure commences behind and above below the apex, and reaches downwards and forwards to the anterior part of the basis of the lung. On the right lung, a second fissure passes upwards and forwards before the termination of the last.

2. The internal surface, above flat, below excavated, presents, in the centre between basis and apex, and rather towards the posterior border, a surface one inch high, a depression half an inch broad (the root, *radix, hilus*), at which *bronchi, arteries,* and nerves enter, and veins and lymphatics pass out. Behind the root the internal surface looks towards the vertebral column; and, on the left side, towards *aorta descendens* [the lung has a corresponding groove], and the superior part of *Ductus thoracicus*, on the right side, towards *V. azygos, œsophagus*, and the inferior part of the *duct. thoracicus*; before the root on the left lung, the left border, the apex of the heart and *Aorta descendens*; on the right lung, the right auricle of the heart and *V. cava superior*.

3. The anterior border is thin, and presents two notches: an inferior (to the left for the apex, to the right for the auricle of the heart); and a superior (to the left for *Art. subclavia*, the right for *V. cava superior*).

4. The posterior border is broad, obtuse, and lies at the side of the vertical column.

5. Basis is hollowed out, rests upon the (convex) diaphragm; its posterior border reaches deeper downwards than the anterior, almost as far as the inferior surface of the liver.

6. Apex, is round, and projects (one inch) upwards above the first rib.

The left lung is narrower and lighter, but longer than the right (on account of the heart); has one fissure (*incisura*) and two lobes, a larger superior, a smaller inferior.

The right lung is less (in the vertical diameter, on account of the liver), but broader; has two *incisuræ* and three lobes; the larger superior, the smaller inferior, and the smallest central lobe.

Parenchyma of the lungs. The spongy and soft tissue of the lung is very strong, elastic, crepitates under the pressure of the finger when respiration has been once performed, and consists of the following parts:

a. *Aëriferous vessels, vasa aërofera.* After the *Bronchi* have divided many times (always at an acute angle), the small branches (*bronchia*) lose the regular structure of the larger; the cartilages on the anterior wall are no longer in the shape of the letter C, but irregular, and are finally entirely lost, like the muscular fibres, until at last vesicles with roundish corners, and terminating in a cul-de-sac, *vesiculæ pulmonales* s. *cellulæ aëræ* (of one-sixth to one-sixteenth of a line), remain, which consist of mucous membrane and thin longitudinal fasciculi of uniting tissue. The pulmonary vesicles open into a common canal, to which they hang like berries upon their stalks (as in glands), and form a pulmonary lobule (*lobulus*). The pulmonary lobules are again associated in one great canal into a lobe (*lobus*), and are, like these, isolated from one another by the serous membrane which forms their envelope.

b. *Pulmonary vessels, vasa pulmonalia.*—1. *Art. pulmonalis* ramifies with the branches of the *bronchi*, and surrounds the *lobuli* with a large circle of capillary vessels, and the pulmonary vesicles with a smaller and more delicate rete (of 0.02 to 0.06 of a line diam.), between the meshes of which the vesicles lie, so that through the thin wall of both the inspired air (in the vesicles) comes into immediate relation with the venous blood (in the arteries) and changes it into bright red, arterial blood, which through: 2. *Vv. pulmonales* flows back again into the heart. Two pulmonary venous branches (to each branch of the pulmonary artery) arise from the capillary rete of the *art. pulmonal.* and *bronchialis*.

c. *Bronchial vessels, vasa bronchialia.*—1. *Artt. bronchiales* do not pass to the pulmonary vesicles, but to the walls of the *bronchia*, *art. pulmonalis*, to the Bronchial glands, to the uniting tissue between the lobules and the *pleura*; they serve for the nourishment of, and for secretion in, these parts; they arise from the *Aorta thoracica* and *mammaria interna*, and frequently anastomose with *A. pulmonalis*; passing into the commencements of *vv. bronchiales*, but also the *vv. pulmonales*.—2. *Vv. bronchiales* open inside the lung into the *Vv. pulmonales*; outside, upon the right side into *ven. azygos*, upon the left side into *Ven. intercostal. superior*.

d. The lymphatics, superficial, are very numerous; a trunk also passes out from the interior of the lung at the root; however, in their interior the *réte* is not yet sufficiently demonstrated; they pass into the *gl. bronchiales* and *tracheales*, which become black between the tenth and twentieth year.

e. Nerves: branches of *N. vagus* and (a few) of *N. sympathicus* form a *plexus pulmonalis anterior*, which spread upon the *bronchia* in the interior, and a posterior which go to the larger branches of the *Bronchi*.

f. Interlobular uniting tissue, consists of fine fibres which surround the vesicles in thin, the lobules in rather thicker *laminæ*, containing no fat, but with time on the surface of the lung the colouring matter which produces the black spotted appearance.

Function of the Lungs. The change of the venous into arterial blood, effected by the inspiration of atmospherical air, and excretion of carbonic acid, resulting from expiration.

468.

4. The *Pleuræ*, *Sacci pleuræ*,

are two closed serous sacs, one of which covers each lateral half of the thoracic cavity, and then the lung. We distinguish:

a. *Pleura costalis*, that is, the part which loosely attached to the internal surfaces of the ribs and *mm. intercostales*, extends from the border of the *sternum* to the sides of the dorsal vertebra, covering before the *vasa mammaria*, behind (before the heads of the ribs) the *ganglia n. sympathici*, and projecting above over the first rib and the apex of the lung.

b. *Pleura phrenica* passes off below from the *pl. costalis*, firmly attached to the superior surface of the diaphragm, and by a triangular fold, *lig. pulmonis*, with the posterior border of the inferior lobes of the lungs, and with the pulmonary veins.

c. *Mediastinum*, is that part of the *Pleura* which is reflected before from the borders of the *Sternum*, behind from the sides of the dorsal vertebra upon the roots of the lungs, whereby a *mediastinum anticum* and *posticum* arises. The anterior mediastinum is different on both sides; the right, for instance, commences above from the right border of the *manubrium*; below from the centre, indeed from the left border of *corpus sterni*; the left, from the left border of *manubrium sterni*, and below from the external extremity of the sixth and seventh rib cartilages. Between the two anterior and the two posterior mediastina an X shaped space remains, *cavum mediastini*, which is divided by the heart (or, as the French describe it with greater accuracy, by the roots of the lungs), into an anterior and posterior.

1. *Cavum mediastini antici*, is bounded before by the *Sternum* and the left rib cartilages, laterally by the two *anterior mediastini*, behind by *pericardium*, the great vessels, and above by the *trachea*. Above narrow and vertical, below sloping and directed towards the left; it contains:

the *Thymus gland* [or its remains], *nn. phrenici*, *glandul. mediastini*

antic., adipose and uniting tissue which is connected above with that on the anterior part of the neck, below with that of the anterior abdominal parietes.

2. *Cavum mediastini postici*, more spacious than the anterior, not oblique, bounded before by the pericardium and roots of the lungs, behind by the bodies of the dorsal vertebra, laterally by the posterior mediastini; contains:

aorta thoracica, *œsophagus*, *nn. vagi*, *duct. thoracicus*, *vv. azygos* and *hemi-azygos*, uniting tissue, *gland. mediast. post.*

d. *Pleura pulmonalis* is formed by the *mediastini* of the roots of the lungs, the vessels passing in and out of which they envelope, being reflected upon the internal surface of each lung, and firmly attached covering the external surface; also entering between the lobes, and forming *ligg. interlobularia*. Thus also there remains between *Pleura pulmonalis* and the other portions of the *Pleura* a closed cavity, the smooth moist walls of which frequently secrete a serous fluid, lie close together, and (frequently) are in places united with each other.

Vessels are doubtful. Branches of the neighbouring *intercostales*, *mammariæ internæ*, *phrenicæ superr.*, &c., form a capillary network which manifests itself in inflammation, but only on the external surface of the *Pleura*.—Lymphatics: numerous, open into *plex. mammar.* and *intercostalis*.—Nerves: not yet found out.

469. Thymus Gland, *Glandula thymus*,

the sweetbread, a so-called blood gland, grows from the third month of fetal life until the termination of the first year after birth, then by degrees diminishes from below upwards, and entirely disappears with the twelfth year. In its complete perfection it consists of two lateral lobes (only associated by uniting tissue) so that properly we must admit two flat, three-cornered thymus glands above and below pointed, which are situated in the superior part of *cavum mediastini antici*, before the junction of the *vv. anonymæ*, behind the *manubrium sterni*, reach as far upwards as the *thyroid* gland, and contain a large cavity filled with white fluid (F. W. Becker), with which the cavities of the lobules, the size of a pea, are connected. The cavity is not bounded by a proper membrane. Astley Cooper maintained that a large lymphatic vessel, which opens into the *vena anonyma*, served as an excretory duct.

The Parenchyma is, like that of the *thyroid* gland, pale red. The lateral lobes divide into three or four larger, and these again into a number of smaller lobuli, which are associated together by uniting tissue, in which fat cells are present. The corpuscles which exist in the lobules, resemble the nuclei of the blood discs and the globules of demolished nerve substance (Ehrenberg).

Vessels: *Artt. thymicæ* come from *art. mammaria interna* and *subclavia*,

sometimes from *thyreoidæa*, *carotis*, or *arcus aortæ*. Veins open into: *v. cava sup.*, *subclavia*, *thyreoid.*, *mammaria interna*.

Function (see Blood glands).

The Urinary Organs, *Organa uropoëtica*.

470. 1. The kidneys, *renes*, νεφροί, are two dense glands (*gl. tubulosæ*) in the *reg. lumbalis*, close to the sides of the first to third lumbar vertebra, outside the peritoneum, surrounded by uniting tissue with abundance of fat; generally smooth on the surface, sometimes (as in the fœtus and several animals) grooved. The right kidney lies rather lower than the left (on account of the liver). Length: three and a half to four inches. Breadth: two inches. Thickness: one inch. Weight: two to four ounces. Colour: reddish brown. Figure: bean-shaped; the fissure [*Hilus*] directed inwards towards the vertebral column. Position: upright.

a. The anterior surface looks rather outwards, is convex; the left covered by *Colon descendens*, above by the *Spleen* and *cauda pancreatis*; the right by *colon ascend.*, *lobus dexter* of the liver and *pars descend. duodeni*.

b. The posterior surface looks inwards, is less convex; behind covered by *m. quadratus lumborum*; separated by the *diaphragm* from the three last ribs, by *m. psoas* from the vertebral column.

The external, convex semi-elliptical border looks backwards; the internal border forwards, and is deeply notched (*incisura s. hilus renalis*). This *hilus* is fifteen to eighteen lines in length; behind we arrive at the pelvis of the kidney, before *Vena renalis*.

The superior border looks inwards, and is surrounded by the suprarenal capsules; the inferior smaller border outwards, and it projects down below the last rib.

Structure of the kidneys. 1. Between the fatty uniting tissue (*capsula adiposa*) which surrounds the kidney and the *Parenchyma* we find a firmly adherent fibrous tunic, prolonged over both surfaces (*tunica propria s. albuginea*). 2. The tissue of the gland itself consists of a *cortical* and a *medullary* substance.

a. The cortical, vascular substance, *substantia corticalis s. vasculosa*, [secreting portion,] a thin, soft, red, sometimes yellow layer on the surface of the kidney, which forms columnar processes within the following substance, and thus, septa between the Malpighian pyramids. In it we find numerous fasciculi of very serpentine canaliculi, which terminate in a cul-de-sac, or, more probably, in a convoluted form [loops], *tubuli, uriniferi corticales*, which pass into the tubular substance. Farther, a number of round red granules, *glomeruli s. acini Malpighii*; they are small convolutions of vessels which lie between the windings of the above mentioned canaliculi, which are smaller than they are, and give off *vasa efferentia*, from which the capillary network about the uriniferous tubes and the commencements of the renal veins passes forth.

b. The tubular medullary substance, s. *tubulosa*, s. *medullaris* [the excretory portion], paler than the former, striated like muscular fibres, consists of twelve to fourteen (twenty) conical lobes (*pyramides Malpighii*), which are separated from one another by the cortical substance, and are covered by the same also on the basis which is directed towards the surface of the kidney, whilst the free apex terminates in the *hilus* like a nipple, as *papilla renalis*. There are generally only ten to twelve *papillæ*, because some have blended together. Each Malpighian pyramid consists of several fasciculi (these are *pyramides Ferreinii*) of parallel canaliculi, *tubuli uriniferi recti* s. *Belliniani*, which open with fine orifices on the renal papillæ, or rather on the walls of a fossa two or three lines deep, inside the papillæ, that is, *ductus papillar. Ferrein.* The uriniferous tubes consist of a clear structureless *memb. propria*, and have a diameter of 0.009 to 0.016 line.

(*Renuli*, s. *lobi renis*, is a name given to the Malpighian pyramids which in early youth, in animals throughout the whole of life, are limited to the surface of the kidney, so that the organ appears to consist of so many small kidneys.)

The vessels for the most part go into the cortical substance. The great *art. renalis* divides in the *hilus* into two or three large branches, which again divide at the boundary between the cortical and medullary substance, and form a capillary network, the close meshes of which surround the basis of each Malpighian pyramid, dispatch branches thence into the cortical substance, which divide in a forked manner, and pass along the undulating *tubuli* into the red granules (*acini Malp.*). *Vena renalis* passes out of the *hilus* before the artery, and sinks into the *ven. cava inferior*. The vessels of one lobe do not communicate with those of another. Lymphatics: numerous, on the surface. Nerves: numerous, from *plexus solaris*, *N. splanchnicus minor*. From *plexus renalis*, *plexus spermaticus* passes off.

Function of the kidneys: Secretion of the urine (in the urinary canaliculi).

471. 2. Excretory ducts of the kidneys. These are the *renal calyces*, the *pelvis renalis*, and the *ureters*.

a. The *Calyces renales*, s. *infundibula*, are small, membranous, sometimes forked cylinders, which surround the basis of one or more renal papillæ. Their mucous membrane terminates blindly upon the papillæ, but at the same time blind processes pass into the substance of the latter, where the urinary canaliculi open. (Henle.) They are surrounded by the fat of the *hilus*, are present in indefinite number (seven to fourteen), and, arranged in rows, they pass into three branches, which form again.

b. The pelvis of the kidney, *pelvis renalis*. This is funnel-shaped, flat from before backwards, projects out behind *art.* and *ven. renalis* from the inferior extremity of the *hilus*, is very extensible, and contracts as it proceeds into:

c. The *ureter*, that is the long (ten or twelve inches) membranous tube which descends on either side to the *basis* of the bladder. Generally of the thickness of a raven's or goose's quill; the ureter may be, with its thin whitish wall, considerably distended. We find sometimes two ureters on one side if the renal calyces have not united into a single pelvis. Direction: obliquely downwards and inwards to the sides of the *basis oss. sacri*, then

downwards, forwards, and lastly inwards, where, arriving at the sides of the *fundus vesicæ*, it passes in this for about ten lines between the muscular and mucous coats, and opens with a narrow mouth into the cavity of the urinary bladder, at the posterior angle of *Corp. trigonum*. Position: as far as to *Basis oss. sacri*, along the anterior border of *m. psoas*; behind the peritoneum and *Vasa Spermatica* (which cross obliquely with it); the right ureter (externally) close to *V. cava inferior*. At the *basis oss. sacri* the ureter crosses the *vasa Iliaca* (forwards and inwards); in the small pelvis: with *Art. umbilicalis, vasa obturatoria, Vas deferens* (in the male); the superior and lateral parts of the *vagina* (in the female). When within the bladder it lies behind *Collum uteri* (hence retention of urine at child-birth, &c.).

Structure of the excretory ducts. 1. The mucous membrane is white, smooth, and in folds, without valves, covered with pavement epithelium. 2. The middle coat, *tunica propria*. 3. The external coat is thick, consists of smooth muscular tissue, the circular fibres of which (as in all excretory ducts of glands) form the external, the longitudinal fibres, the internal thicker layer.

472. 3. The urinary bladder, *vesica urinaria s. cystis*,

is a membranous, roundish sac (in the fœtus pointed above), which is situated in the cavity of the small pelvis close behind the bones of the *pubes*, and is for the purpose of holding the urine. It is held in its situation by *fascia pelvis*, and *peritonæum*; *ligg. vesicalia lateralia* (the obliterated *artt. umbilicales*) and *medium* (the obliterated *urachus*); *ligg. pubo-vesicalia* (3) from the *symphysis* to the neck of the bladder in the female, or *ligg. pubo-prostatica* in the male. The capacity of the bladder is different according to the habits of individuals, &c., before birth proportionably larger than afterwards, in the female likewise larger than in the male, where it holds from 7 to 14 ounces of fluid. Direction of the axis: from above and before downwards and backwards.

Divisions: the top, *vertex*, is the superior, smallest; body, *corpus*, the central; basis, *fundus*, is the most inferior and broadest part of the bladder.

The external convex surface presents the following parts:—

1. The anterior wall is situated close behind the *symphysis, corp. oss. pubis*, and *mm. obturat. intern.*, with loose, uniting tissue only interspersed, and without *peritonæum*; in the female (because the prostate is wanting), rather under the *Symphysis*; and above it, close behind the abdominal walls, when the bladder is distended.

2. The posterior wall, quite covered by *peritonæum*, is situated before the *rectum* (in the male); before the *Uterus* (in the female); nevertheless, small intestines generally slip in between.

3. The lateral parietes, covered by *peritonæum*, close to *Art. umbilicales* (*s. lig. lateralis*), and *Vasa deferentia* (in the male).

4. The inferior wall, *basis*. a. In the male: above the *vesiculæ seminales* and *Vasa deferentia*, and the triangular piece of the *rectum* between them,

which, however, when the bladder is empty, is separated from it by the *peritonæum*. At the sides of the basis are situated: uniting tissue, and *Mm. levatores ani*. b. In the female: firmly on and above the *Vagina*, and loosely on the inferior half of *collum uteri*.

5. The superior wall, *vertex*, *apex*, is directed forwards and upwards, and covered by the *peritonæum*. In an upright position the intestines rest upon it. In front the *urachus* s. *lig. suspensorium* passes off from it, ascending to the *umbilicus*. This membranous cord is the remains of a canal which, even in the human embryo (in those of quadrupeds it is certain) up to the fourth month, is said to pass through by the umbilical cord into the *allantois*. Compare the history of development.

6. The neck of the bladder, *collum vesicæ*, in the narrow part of the bladder, at the most inferior region of the anterior vesical wall, which in the male is surrounded by the prostate, and lies close behind the inferior border of the *symphys. pubis* (in the female above the *vagina*).

Structure of the urinary bladder: 1. Mucous membrane, whitish and thin, with a few mucous follicles (in the neighbourhood of the neck); strong and sensitive, presents numerous folds, which disappear upon extension of the bladder, and a columnar or network appearance, according as the fibres of the muscular tunic project. Besides, the openings of the two ureters and the urethra, between which arises a smooth triangle, *corpus trigonum*, bounded by two slight folds, *plicæ uretericæ*, which are situated behind the neck of the bladder, and before the *fundus vesicæ*, frequently forming a pouch on either side (*sinus vesical.*).

2. The muscular coat invests the mucous membrane, with which it is united by a thin layer of uniting tissue (*tunica propria*) is externally thin, and consists of—

a. An external layer of longitudinal fibres, which ascend from the neck of the bladder on the anterior and posterior wall to the *vertex*, and pass as *m. detrusor urinæ*.

b. An internal layer, which consists partly of regular or irregular circular fibres crossing each other (the first at the *fundus*, the last particularly on the posterior wall), partly of fibres passing obliquely.

M. Sphincter Vesicæ is just such a fasciculus of circular fibres, which closes the orifice of the urethra into the bladder.

3. The *peritoneum* covers the *vertex* and the posterior surface of the bladder only; reaches in the male (*excavat. recto-vesical.*) deeper downwards than in the female (*excav. vesico-uterina*).

Vessels: *Artt. vesicales*, from the *hypogastrica* and its branches. Veins form *plexus vesical.* about the neck of the bladder, and open into *V. hypogastric.* Lymphatics: they mostly lie between peritoneum and the muscular coat, and pass into *plex. hypogastric.* Nerves: branches of *plexus hypogastricus lateralis* and *sacralis* (voluntary and involuntary).

Function of the bladder: to hold the urine which continually and guttatim flows in through the ureters, and when contained in sufficient quantity, the resistance of the *sphincter vesic.* is overcome, and it flows out.

473.

4. The Urethra,

is the narrow, cylindrical continuation of the neck of the bladder which passes under the *symphysis pubis* and opens with an external mouth, *ostium cutaneum*, on the external parts of generation.

a. The urethra of the male, *urethra virilis*, from five and a half to nine inches long, four lines broad, passes obliquely forwards and downwards through the *Prostate* (*pars prostat.*) curves, slightly arched downwards, in its course, under the *Symphysis* (*pars membran.*), and lies in a groove between the *corpp. cavern.* on the inferior surface of the penis (*pars cavernosa*), whence it passes forwards through the glans to its anterior mouth.

1. *Pars prostatica* perforates the prostate (or lies in a groove uncovered by it above), is wider at its departure from the neck of the bladder than before, and about ten lines to one inch long. On the posterior wall the mucous membrane forms a narrow fold, *caput gallinaginis* (*colliculus seminalis, veru montanum*), upon which are found the two openings of the *ductus ejaculatorii*, and on the sides of which are the excretory ducts of the *Prostata*, and several radiating bands, *frenula*. Between *Prostata* and mucous membrane there is placed, as in the urinary bladder, a layer of muscular fibres.

2. *Pars membranacea s. isthmus urethræ*, the narrowest part of the urethra (one and a half to two lines diam.) is eight to nine lines long, formed only of the mucous membrane and the *m. constrictor urethræ* [Wilson's and Guthrie's], surrounding it like a ring, lies curved under the *Symphysis pubis*, separated from this by veins, above the *rectum* (between the two a triangular space, the apex of which looks backwards and upwards). This portion permits great distension. The muscular layer is surrounded by many veins. [This portion perforates the two layers of the deep perineal fascia about one inch below the angle of the pubes, three-fourths to a half below the subpubic ligament. The bulb of corp. Spongiosum projects backwards upon its under surface, being applied to the anterior surface of the deep fascia.]

3. *Pars cavernosa s. spongiosa*, the longest portion of the urethra, commences with an enlargement, *bulbus*, which has a diameter of about three lines, is placed in the apex of the pubic angle, is surrounded below by the *corp. cavernos.* [*spongiosum*] *urethræ*, which likewise forms a *bulbus*, and laterally by the *mm. bulbo-cavernosi* and Cowper's glands, and looks forwards and upwards. From the angles in which the roots of the *corpus cavernos.* unite, the urethra passes on the inferior surface of the *penis*, at first above *mm. bulbo-cavernosi*, then close above the skin to the glans; is there enlarged (four lines wide, three-quarters of a line long) into the (*fossa navicularis s. Morgagni*), passes through the middle of the glans [rather, on its under surface], and terminates with a narrow, oval opening (two lines wide) at its point. This portion consists of a fibrous sheath, a spongy body, and the mucous membrane, which here presents particular longitudinal folds, and the oblique mouths of Cowper's glands directed forwards, and those of mucous glands (*gl. Littrii*) in larger depressions (*lacunæ s. sinus Morgagni*).

Vessels of the urethra are numerous, especially in the *fossa navicularis*.

Nerves also from *pudendo-hæmorrhoidal*.

b. The urethra of the female, *urethra muliebris*, about an inch and a half long, and wider than that of the male; passes, only

slightly curved, under the *symphysis pubis*, from the neck of the bladder forwards and downwards, contracts by degrees and opens into *vestibulum vaginæ*. Above a *venous plexus* surrounds it and *ligg. pubo vesicalia*; under the symphysis: the angle of the united crura of the *Clitoris*; below it rests firmly upon the anterior wall of the *Vagina*. The external mouth, surrounded by a small enlargement, lies about one inch under the *Clitoris* above the entrance to the *Vagina*. Its mucous membrane presents longitudinal folds, and the veins passing longitudinally, also, a few openings of mucous crypts; the external coat consists of a thin layer of erectile tissue (like *corp. cavernosum urethræ virilis*) and a thicker of circular muscular fibres (*pubo-urethralis*).

474. The *glandulæ supra-renales, renes succenturiati*, are two small (one inch high, two inches broad), flat, semilunar shaped and spongy blood glands, which in the fœtus and child are larger than in the adult, and surround the superior extremity of the kidneys like a helmet.

The anterior surface of the right supra-renal capsule looks towards the inferior surface of the liver, to the right of *V. cava inferior*; that of the left touches the *Pancreas* and looks towards the *fundus* of the stomach. The posterior surface is attached to the superior part of the crus of the diaphragm, on a plane with the tenth dorsal vertebra, and has the *Nn. splanchnic. major* and *gland. semilunare* behind and close to it. The superior convex border is thin, and looks upwards and inwards. The inferior concave is thick and lies upon the kidney. The surface is surrounded by a thin layer of adipose tissue (not by peritoneum) and a fibrous coat.

Structure. We distinguish a thick, external cortical substance, of a yellow striped appearance; and a pultaceous, chestnut brown, medullary substance, in the interior, which is penetrated by numerous vessels (veins). The lobes perceptible upon the surface, only, are formed by the furrows for vessels.

Vessels: very numerous; *suprarenales*, branches of *phrenic. infer.*; *Aorta*; *cœliaca renalis*. Veins: give rise to the idea of a cavity in the supra renal capsules; they pass into *V. cava infer.* (the right) and *renalis* (the left).

Nerves: from *plx. renalis* and *solaris*.

Function of the supra renal capsules unknown.

475. The Genitals, Organs of Generation, *Organa genitalia s. sexualia*.

I. Of the Male, *Genitalia virilia*,

serve for the preparation, preservation, and excretion of the seminal fluid, and are placed for the most part outside the pelvic cavity.

476.

1. The *Scrotum*, ὄρχεον,

is a pouch-like elongation of the external skin which hangs down before the perinæum between the legs, and encloses both the testicles.

This skin is brownish, thin, and without adipose tissue, wrinkled, loose, and large in warmth, dense, strong, and tightly applied in the cold; beset with delicate and curled (it is said obliquely placed) hairs and many sebaceous glands.

In its centre a linear suture-like elevation, *raphé*, passes from the anus to the root of the penis, which is bounded before by the root of the penis [sometimes extends along it] behind by the anus, and indicates the place where inside the *Scrotum* a vertical septum passes off from the *Dartos* between the testicles—*tunica dartos*, is a red, dense, and very vascular membrane of contractile uniting tissue, which is firmly applied to the internal surface of the *scrotum*, and only loosely to the *tun. vaginalis communis*. The uniting tissue between the last continues into the *fascia femor.* and *abdominal. superfic.*, and becomes changed by pressure into a membrane (e. g., of water). The partition in the central line, *septum scroti*, consists of fibrous and common uniting tissue. The *dartos* above, close to the spermatic cords, is supplied with uniting tissue containing much adipose, and it does not pass into the *fascia superficialis*.

Vessels: *Artt.* and *Vv. scrotales anteriores* (branches of *pudenda externa* and *epigastrica*); *posteriores* (branches of *pudenda communis*).

Lymphatics: numerous; they enter into the *inguinal* glands.

Nerves: branches of the *ileo-inguinal*, *spermatic. extern.* *pudendus* and *cutan. femor. posterior communis*.

477. 2. The testicles, *testes*, *testiculi* s. *didymi*, are two oval glands lying under the penis, which until towards the end of embryonic existence lie in the abdomen, but later, enveloped in a peculiar and common vaginal membrane, inside the *Scrotum*, and the left rather lower than the right. Length: two inches. Breadth: one inch. Thickness: six lines. Weight: one half to one ounce. Each testicle consists of two parts.

a. The proper testicle, *testis*, ὄρχις, is egg-shaped, rather flat on the sides, smooth, and yielding (about as much as the eye), of a whiter hue (*tunica albuginea*). Its superior extremity looks forwards, the inferior backwards; the anterior border downwards, the posterior with the *epididymis*, upwards.

Structure. The *parenchyma* (*pulpa testis*) is soft, doughy, yellowish red; it consists, principally, like that of the kidney, of numerous and many times convoluted tubules, *tubuli semiferi*, which, surrounded by capillary and nervous rete, are associated by uniting tissue into longitudinal lobules, and are surrounded as a whole by a fibrous capsule (*tunica albuginea* s. *propria*), which

last again involves itself in a serous sac (*tun. vaginalis propria testis*). The *tubuli semiferi* commence in blind (or looped?) extremities, at the periphery of the testicle, and form, by means of their many short convolutions, a dense cortical layer, which consists of from one to two hundred lobules (which unfolded measure about from one thousand to one thousand two hundred feet long). The lobules are supported by processes from the *tunica albuginea*, which at the posterior border of the testicle forms a triangular space, *corpus Highmori*, and continues inwards. From this *corp. Highmori* the *tubuli* pass almost directly straight, when they have passed away from the lobules, and then unite at an acute angle into a rete, *rete vasculosum Halleri*. From these arise from nine to thirty *vasa efferentia testis*, which perforate the superior extremity of the *Corpus Highm.*, and pass into the head of the *Epididymis*. They are many times convoluted, present (each) a conical cord, *conus vasculosus Halleri*, the point of which is directed downwards, and they finally unite to form the Canal of the *epididymis*.

The seminal tubules consist (like the urinary) of a structureless membrane, have a diameter of 0.11 to 0.24 of a line, and contain the Spermatic filaments (*spermatozoa*) and the other elements of the Semen.

b. The *Epididymis s. parastata cirsoides*, is the vermiform appendix, two and a half to three inches long, which is placed along the posterior border of the testicle somewhat externally, of a brownish red, and flattened from above to below. Its thicker and broader superior extremity, *caput epididymis*, rests with its concave surface close upon the superior extremity of the testicle; the central part, *corpus*, is surrounded all round by *tun. vaginal.*; the inferior thinner and narrower portion, *cauda*, is again situated close on the inferior extremity of the testicle, and continues, curved downwards, into the *vas deferens*.

Structure. The *epididymis* consists of a single tube, 0.12 to 0.33 lines in diameter, and so often convoluted that its length measures thirty-two feet (Monro), and is a continuation of the *coni vasculosi*, which coalesce in the *caput epididymis*. *Vasculum aberrans Halleri* is a still more minute canal than that of the *epididymis*, which passes upwards from the tail of the last to the *vas deferens*, and is then lost; it arises from the departure of a few seminal vessels in the endeavour to form a second *epididymis*; according to Weber similar blind canals are sometimes present in the *duct. hepatic.* and *pancreatic.*

Vessels of the testicle: *Art. and V. spermatica interna*; the veins arise from the *plexus pampiniformis*.

Lymphatics: *plexus spermaticus*.

Nerves: *plexus spermaticus* (from *plex. renalis n. sympatici*).

Tunica vaginalis propria testis, the serous envelope (*Peritonæum*) of the testicle, is a completely closed sac, in which it is involved (like the lungs in the pleura), so that the one (internal) layer (*t. serosa testis* or visceral) is connected firmly with the testicle (*t. adnata*), the other (external) surrounds it loosely [*t. vaginalis reflexa* or parietal], and a cavity is found between the two, in which a serous fluid is exhaled. The reflection of the external layer upon the testicle takes place at its posterior border, at the *corpus Highmori*. The *epididymis* is separated from the

superior border of the testicle, externally by a kind of mesentery, *lig. epididymidis* s. *mesorchium*, and internally it is covered higher up.

The development of the vaginal membrane into a closed sac is closely connected with the descent of the testicle.

Descensus testiculi.—In the tenth to twelfth week of fetal life we see a small elongated testicle, in a mesentery which passes off from the peritonæum of the posterior abdominal wall, below the kidney. In the fissure which leads to it from the posterior abdominal wall, the *vasa testiculi* are situated, in the centre the *vas deferens*, below, a fibrous thicker cord projects from it into the short straight inguinal canal.

The leading string, *gubernaculum Hunteri*, which is widely fixed to the Scrotum. The testicle increases by degrees, not so the *gubernaculum*, which becomes shortened in proportion to the other parts, and draws down the testicle out of the mesenteric fold, so that the immediately investing and closely attached portion, only (the subsequent *tun. serosa testis*), of the testicle, accompanies it.

In its passage through the inguinal canal, the testicle draws down with it that portion of the peritonæum which is connected with its covering; a cavity appears therefore inside the scrotum, on the external surface of which the testicle, with its vessels, &c., is situated, and which is separated from the cavity of the peritoneum by a constriction only, the vaginal canal, *canalis vaginalis*. (Intestines pass through this canal, in *hernia congenita*; thus they are only separated from the Parenchyma of the testicle [the *tunica albuginea*] by the serous investment of each other, whilst in *hernia acquiesita*, two folds of peritonæum, namely, the hernial sac and *tunica vaginalis testis* [*reflexa*], lie there between them).

So soon as the testicle has arrived at the fundus of the scrotum, the obliteration of the vaginal canal commences, as the *tunica* becomes converted into a ligamentous band of uniting tissue, *habercula*, between the internal inguinal ring and the superior extremity of the testicle.

These filaments even sometimes disappear. The obliteration commences above or below, or from both points at the same time, towards the termination of fetal life; at birth the canal is frequently open, and intestines fall into it, forming a hernia (*hernia inguinalis congenita*). Serum collecting in it forms a *Hydrocele*.

478.

3. The *vas* s. *ductus deferens*,

the continuation of the epididymis, commences at the *cauda* of the last, ascends through the inguinal canal, together with the remaining parts of the spermatic cord into the abdomen, and terminates before the *vesiculæ seminales*, associated with the excretory duct, of which it forms the *ductus ejaculatorius*. In its course we distinguish four parts.

a. *Pars testicularis* passes in a serpentine form from behind forwards and from below upwards along the inner side of the *art. ven.* and *spermatica* and the *epididymis*.

b. *Pars funicularis*, ascends in a proper sheath behind *art. ven. spermatic.*, directly as far as the inguinal canal, inside of the spermatic cord.

c. *Pars inguinalis*, passes through the inguinal canal, inclining from below, upwards, from within, outwards and from before, backwards, continues over the curvature of the *art. epigastrica* forming a part of the spermatic cord.

d. *Pars vesicalis* sinks downwards, at its exit from the inguinal canal and the cord directly into the pelvis, over *Vasa epigastricæ*, at first on the side, then on the posterior surface of the urinary bladder, where it crosses obliquely the *Art. umbilicalis*, and betakes itself inwards and downwards to the *fundus vesicæ* before the *ureter*, then passes transversely inwards to the inner side of the *vesiculæ seminales*, where both *vasa deferentia* almost meet together, and join behind the *prostata*, with the anterior extremities of the seminal vesicles at an acute angle. Two inches above the *vesiculæ seminales* it is thinner and wider.

Structure. Cylindrical, with thick walls, hard, narrow, and only at its inferior extremity expanded; this canal presents an extremely delicate, white, and folded mucous membrane, surrounded by a compact contractile coat, and an external uniting tissue. Muscular fibres exist in large animals (horses) indubitably. Arter.: *spermatica interna* and *vesical*.; very numerous inwards towards the seminal vesicles.

The spermatic cord, *funiculus spermaticus*, a looser cord at the posterior part of the testicle, which, passing with and into the testicle, through the inguinal canal as far as the internal ring, is composed of the following parts, viz.:

1. *Vas deferens* (with *Art.* and *Ven. spermatica deferens*, from *vesicalis inferior*; only sometimes); at the internal posterior part.
2. *Art. spermatica interna*, on the anterior and external side of the *vas deferens*.
3. *Ven. spermatic. interna*, with *plexus pampiniformis*.
4. *Plexus spermatic. lymphaticus*.
5. *Nerv. spermaticus extern.* (branches of *genito-cruralis*), *Plex. spermatic. (n. symphaticus)*.
6. *Habercula* (the obliterated *tunica propria testis*), and sometimes
7. *Vasculum aberrans Halleri*.

The above mentioned parts are united by an adipose uniting tissue (*tunica propria funiculi*), and they are held firmly together by the

Tunica vaginalis communis testiculi et funiculi. This last is a fibrous membrane, covered by *m. cremaster*, which surrounds the *tunica propria* of the testicle, and is connected through the inguinal canal with the uniting tissue between *fascia transversalis* and peritoneum. (It becomes thicker and stronger from pressure, e. g., of fluid.)

479. 4. *Vesiculæ seminales s. spermaticæ*,

two longish, flattened, irregular sacs, between the rectum and bladder, along the external side of the *vasa deferentia*, lying at the anterior extremity close to one another and diverging back-

wards. Length: from two to two inches and a half. Breadth: six lines. Depth: from two to three lines. The internal surface consists of a cavity divided into from ten to fifteen compartments (of about six to eight lines long), is striated and in folds, like the *vas deferens*, the external coat of which, however, is thicker. They contain a yellowish brown viscous fluid. The anterior pointed extremity of each seminal vesicle, which is surrounded by the *Prostata*, forms the excretory duct which, united with the *vas deferens* of each side, passes into the *ductus ejaculatorius*, the ejaculatory duct for the semen, which, likewise, very short, but with thin walls, oblique from above, downwards and inwards through the *basis prostaticæ*, opens upon the *veru montanum* of the urethra, with a narrow mouth, whilst its posterior extremity is wider.

Function of the testicle. It is to secrete the semen, which, preserved in the seminal vesicles, is carried through the *ductus ejaculatorius* into the *urethra*, and there mixes with the fluids of the Prostate, and the glands of Cowper.

480. 5. The prostate gland, *glandula prostata*, a whitish conical gland, blunted in front, twelve lines thick, fifteen long and eighteen broad, placed behind and below the *Symphys. pubis*, before the neck of the bladder and the rectum, rather obliquely from above and behind to below and before; and is perforated by the urethra and the *ductus ejaculatorii*. Its inferior surface rests upon the anterior surface of the rectum, attached by uniting tissue, is flat, and in the centre separated by a longitudinal groove into two equal parts.

The superior surface lies under the *ligg. pubo-prostatica*, and some lines below the pubic angle. The sides are surrounded by *M. levator ani*. The *basis*, that is, the posterior extremity, presents two larger lateral lobes and a central, bean-shaped, hidden between the two, surrounding the neck of the bladder, and farther backwards the narrow portion of the seminal vesicles. The blunt apex directed forwards and downwards terminates behind the *pars membran. urethræ*. The canal for the urethra is situated rather above the centre, is often open above, and placed in rare cases on the inferior surface of the *Prostata*.

Structure. The Parenchyma of the Prostate, which consists of lobules, forms roundish glandular cells of fibrous tissue, surrounded by vascular rete. The cells, closely compressed together, are connected with one another by small canals, from the junction of which from twelve to fifteen excretory ducts are formed, which pass obliquely from behind forwards in the gland, and open close to the *veru montanum*, with very fine orifices, into the urethra, for the purpose of discharging a whitish viscous fluid, *liquor prostaticus*. The fibrous envelope of the prostate gives to it its external firmness, whilst the

substance itself is easily lacerable. *M. transvers. prostatae*—only exists in muscular men.

Artt. they come from *A. vesical., hæmorrhoid., media* or *vesicales*. The veins are numerous; its plexus is connected with *pl. vesical.* and *hæmorrhoidalis*.

Nerves: they are branches of *pl. hypogast. nerv. sympathici*.

481. 6. Cowper's glands, *glandulæ Cowperi*,

are two irregular glands, the size of a pea and yellowish red, the lobes of which, consisting of small fossæ, open into two or three excretory ducts, common to them all, which, after a passage of one and a half to two inches on the inferior wall of the urethra, penetrate, obliquely, the mucous membrane at the commencement of *pars. cavernos. urethræ*. They lie close before the prostate, under the *bulbus urethræ* [rather behind it] between the two *m. constrict. isthmi urethræ*, surrounded by *m. bulbo-cavernosi*; and secrete a yellowish mucus.

482. 7. The male organ, *membrum virile, penis, virga, coles*,

is a cylindrical, spongy body, in a state of erection three-cornered (and then eight inches long), on the inferior surface of which the *pars cavernosa* [*spongiosa*] *urethræ* is applied. Its posterior extremity, *radix* s. *crura penis*, is thicker and attached on either side to the pelvis; its anterior extremity, nut, *glans*, pointed and rounded; its superior surface, *dorsum*, flattened and presenting a longitudinal *sulcus* for *vasa dorsalia penis*; its inferior surface is convex, and presents the urethræ in a deep groove.

The penis consists of the *corp. cavernosum penis*, the *pars cavernosa urethræ* with its *corpus cavernosum* [*spongiosum*], the *glans* and muscles (which see).

a. *Corpus cavernosum* (s. *corpora cavernosa*) *penis*, is a roundish body, springing with two roots from the internal surfaces of the *rami ascend. oss. Ischii* (close above the *tuber Ischi*), which passes away from under the *symphysis pubis*, where its roots lie close together, as far as the *glans*, into which its anterior rounded and smaller extremity projects, without communicating with it. On its superior surface the *vasa dorsalia penis* pass, in its inferior deep groove, the *pars cavernosa* of the urethra. A fibrous vertical partition, *septum penis*, separates the two halves of the *corpus cavernosum* (hence the appellation *two corpp. cavernosa*), which, however, are more or less connected together, since the veins of the one pass over into those of the other side.

Structure. The cavernous bodies consist of, 1. a thick, strong, and extensible fibrous envelope, *albuginea*, from which a *septum* passes off in the centre; 2. of an erectile tissue, *tela erectilis*, which consists of cylindrical fasciculi of uniting tissue, which cross each other very frequently; contain a blood-vessel and form, with the processes (bands, *trabeculæ*) passing off from the *albuginea*, cellular spaces. The small cells communicate with one another. In them is placed a very convoluted vascular rete, the principal mass of which is formed of veins which consist of *tunica vasorum communis*, only. They

pass very much convolved into their *plexus cavernosus*, and still even present enlargements, *sinus venosi*, although unusually large. A portion of the arteries (*Artt. helicinae Müller*), which contribute towards erection, are said to open directly into these *sinuses*.

b. *Corpus cavernosum urethræ*, the spongy body of the urethra, which it surrounds like a sheath, and extends from the *symphysis*, where it is surrounded by *m. bulbo-cavernosus*, and swells out like a bulb (*bulbus cavernosus*) [*spongiosum*], to the inferior surface of the *penis*, as far as the *glans*, without communicating with the *corpus cavernosum penis*, but with the *glans*. Its structure is just the same as the last, only the *septum* is wanting.

c. The nut, *glans penis*, *βαλανός*, the anterior blunted, conical extremity of the member, is perforated by the urethra, the elongated opening of which it presents at its apex. The excavated *basis* of the *glans* projects over the *corp. cavern.* *penis*, which lies within it, so that an enlarged border, distinctly beset with nervous papillæ, *corona glandis*, appears. The superior convex surface is smooth, the inferior flat surface smaller, and divided by a longitudinal sulcus into two tubercles, between which, as far inwards as the *corona*, the cord (*frenulum præputii*) is attached, which is a fold of the prepuce. The parenchyma of the *glans* is of the same character as that of the spongy body, only more closely compressed. It is connected with the *corp. cavernos. urethræ*.

d. The external coverings of the penis.

1. *Fascia penis*, a continuation of *f. perinæi*, forms the *lig. pubo-prostaticum*, which extends from the roots of the *corp. cavern. penis* to the *lig. arcuatum*, and is perforated by the *urethra*; covers upon the *dorsum* of the penis the *Vasa dorsalia*, and reaches as far as the *glans*.

2. The external skin, attached by loose uniting tissue, destitute of fat, to the fascia, is very thin, brownish, hairless, and moveable, and by these circumstances is distinguished from the skin above and behind the root of the *penis*, on the *pubes*, *mons veneris*. Behind the *corona glandis* the skin, instead of passing over directly upon it, leaves the *glans*, passes away as far as over the orifice of the urethra, is then reflected, and goes as far back as the posterior border of the *glans*; very delicate, vascular, and firmly attached to the last and to the mucous membrane of the urethra. Thus the foreskin (*præputium*) arises, a free sheath, consisting of two layers, the internal of which is attached as *frenulum præputii* to the inferior surface of the *glans*, and behind *corona glandis* is beset with numerous sebaceous glands, *glandulæ præputiales* s. *odorifera Tysonianæ*, and secretes the *smegma præputii*. The opening of the prepuce is frequently too much contracted, the frenulum too long, as it reaches as far as the orifice of the urethra.

3. *Lig. suspensorium penis*, a triangular, yellow, elastic band in the central line between *Symphysis pubis* and *corp. cavernosum penis*, serving to fasten it, is a continuation of the decussation of *lig. Pouparti*. It does not possess muscular fibres (*m. pubo-cavernosus*, sometimes; it is a portion of *bulbo-cavernosus*).

The vessels of the *Penis*: *Arter. profunda penis* goes partly into the veins, partly into the blindly terminating (Müller) or looped *Art. helicinae* projecting into the sinus of the veins; *art. dorsalis penis*. Veins: *dorsalis penis* (forms a sinus), only one, between two arteries.

Nerves: *N. pudendus communis*; *plexus cavernosus N. sympathici*, most of the branches to the *glans*. After division of the *n. dorsalis penis*, the *corp. cavernosa* collapse, become more vascular, but incapable of erection.

II. The Organs of Generation in the Female, *Genitalia muliebria.*

They are situated, for the most part, within the pelvic cavity.

483. 1. The ovaries, *ovaria* s. *testes*, *muliebres* (Galen), are two semioval whitish glands, flattened from before to behind, transverse at the entrance of the small pelvis, one of which is situated on either side of the *uterus*, behind and below the *Fallopian tube*. The convex anterior and posterior surfaces and the superior border are free (enveloped in *peritonæum*); the straight or concave inferior border, where the vessels and nerves pass in (*hilus ovarii*), is connected with the broad ligament of the uterus; the internal extremity by a fibrous cord, *lig. ovarii*, with the superior angle of the *Uterus*; the external extremity with the fringe of the *tuba Fallopiæ*. The surface of the ovaries is not always irregular and uneven.

In the virgin: Length: eighteen to twenty-three lines; breadth: nine to twelve lines; thickness: four and a half to five lines; weight: eighty to a hundred and ten grains.

In women of thirty-five to forty years old: Length: twelve to eighteen lines; breadth: six to seven; thickness: three to four; weight: forty grains.

Position: in the fœtus in the *regio lumbalis* (like the testicles); during pregnancy in the abdominal cavity, also after delivery in the *fossæ iliacæ*; and very frequently behind the Uterus.

Structure. The parenchyma of the ovary is immediately covered by (fibrous) uniting tissue, *tunica propria* s. *albuginea*, which receives a serous investment from the peritoneum, so that the fossa of the *hilus ovarii* only remains free. The parenchyma itself (*stroma*) consists of a loose, but yet dense uniting tissue, penetrated by numerous blood-vessels, and containing twelve to fifteen roundish, transparent vesicles, of one half to four lines diam.; these are, *folliculi* s. *vesiculæ* (*ovula*) *Graafii*, the largest of which lie close to the periphery. In impregnation, a Graafian vesicle bursts after it has filled with blood; it is emptied of its contents, the blood changes colour, and is metamorphosed into the cicatrizing matter, which is *corpus luteum*, the yellow body.

484. The Graafian vesicle is to be regarded as a cell of the ovary. It consists of a very vascular, dense *tunica propria* (*theca*, of Baer) which encloses a clear fluid, mixed with some fat globules and with elementary granules only, and the *ovum*. Each granule forms a connected layer of cells (*membrana granulosa*), which covers the internal surface of the vesicle, and attaches the *ovum* to its wall, since it surrounds it above and below, like Epithelium.

The egg, *ovulum*, appears to the unassisted eye as a white punctule, is still covered on its exit from the Graafian vesicle by a remnant of the granular layer (that is, *discus proligerus* of Baer), which is lost upon the entrance of the egg into the Fallopian tube. It is 0·08 of a line in size, consists of a clear, structureless, firm, and close envelope, *chorion*, and fluid contents, the yelk.

Chorion, yolk membrane, is single, indivisible (a *zona pellucida*, that is to say, a space filled with fluid between the yolk and the *membrana granulosa* does not exist). The yolk contains a thick mass of whitish yellow, brilliant granules and globules, the size of which equals the fat globules. Surrounded by, and close beneath the *Chorion*, lies the

Germinal, or vesicle of Purkinje, *vesicula germinativa*. It is round, clear as water, and so much the larger the smaller the egg, consists of a smooth, structureless membrane, and contains, besides, a very clear albuminous fluid, a dark granule, the germinal spot (*macula germinativa*).

Vessels of the Ovary. Arter.: *ovarica* branches of the *uterina*. Veins and lymphatics like the arteries.

Nerves: *plex. spermat. intern.* from *sympathicus*.

485. 2. The Fallopian tubes, *tubæ Fallopiæ*, two membranous tubes, four inches long, lying transversely between the Uterus and the external wall of the pelvic entrance (one upon either side), before and above the ovary, behind the round ligament. The external extremity, *extremitas abdominalis*, consists of thin, extensible walls, curves backwards and inwards towards the external extremity of the ovary, and opens with an orifice a line wide into the abdominal cavity, surrounded by fringed lobules, *fimbriæ lacinix s. morsus diaboli*. One of these lobules (the innermost) is connected by means of a ligament with the *Ovarium*, which it surrounds like a funnel, in consequence of the flow of blood to it after conception. The inner extremity, *extrem. uterina*, is firm, and not extensible, and opens into the cavity of the Uterus at the superior angle with a very narrow orifice (one fourth of a line) obliquely inwards and downwards. A (narrow) canal consequently leads from the cavity of the Uterus directly into the cavity of the abdomen.

Structure. The tuba consists of three coats: a. The serous coat (peritoneum); a continuation of the *lig. uteri latum* passes to the external orifice, where it also passes on to the fringe and over into the mucous membrane (the only instance of such a transition); the peritoneum is likewise open at this point.

b. The central, very vascular coat, a continuation of the tissue of the *Uterus*, contains, in the larger animals at least, muscular fibres; the internal fibres pass longitudinally; the external transversely.

c. The innermost coat, mucous membrane, presents, especially at the external extremity, many longitudinal folds, *rugæ longitudinal.*, and passes into the *tunica serosa*. Arteries; from the *uterina* and *spermat. interna*. Veins; in the *plex. pampiniform.* and *v. uterina*.

Function: a. The conveyance of the male semen to the ovary (?). b. The reception and conveyance of the *ovum* from the ovary into the *Uterus*.

486. 3. The Womb, *Uterus*,

a pear-shaped bag, flattened from before to behind; its broadest closed extremity directed upwards, its narrow open extremity

downwards; it lies in the centre of the small pelvis, between the urinary bladder and rectum, above the *Vagina*, in a fold of the peritoneum; very moveable. Direction: oblique from above downwards, and from before backwards; sometimes, but generally in pregnancy, from above downwards, and from right to left. Dimensions: in the mature virgin two and a half to three inches deep, six lines thick, above sixteen to eighteen broad; at the neck six lines broad; weight: six to ten drachms.

We distinguish the following parts: the base, *fundus*, the most superior, broadest, and convex; *corpus*, the central, longer; *collum*, the most inferior and narrowest portion, which passes obliquely downwards and backwards, and projects with its rounded extremity freely into the *Vagina*. This vaginal portion, *portio vaginalis*, in front six, behind five lines long, presents upon its inferior uneven surface, the so-called *os tincæ*, a transverse fissure, that is, the external opening of the Uterus, *orificium uteri externum*, which is bounded before by a thick and long lip (*labium anterius*), behind by a thinner and shorter lip (*labium posterius*), which are smooth in the virgin, but otherwise indented. The anterior surface a little convex, covered as far as the neck by peritoneum, is attached from the neck downwards by loose uniting tissue to the fundus of the urinary bladder. The posterior surface convex, entirely covered by the peritoneum, lies on the anterior wall of the *rectum*. The superior border convex, does not reach as high as the pelvic inlet. The lateral borders form, with the superior of either side, an angle, where the *tuba* opens; and under that the *lig. rotundum* is attached. *Ligg. lata* adhere to them.

The cavity, *cavum uteri*, is narrow; and in the *fundus* and *corpus* triangular; the apex leads into the cylindrical canal of the neck through the internal mouth of the Uterus, *orific. uteri internum*. The walls are four to six lines thick, the thinnest (two lines) at the place where the *tubæ* are affixed.

Structure of the *Uterus*. The parenchyma is grayish-brown, very dense and firm, and consists of several layers of a very thick fibrous tissue, which in the gravid state and in animals is regarded as muscular substance. It is penetrated by numerous vessels (veins). At the *collum* we see only circular fibres crossing at acute angles; on the *body* and *fundus* a superficial layer of longitudinal and oblique fibres, which converge to the lateral borders, and a deep layer of circular fibres. In the unimpregnated uterus the fibres are similar to the undeveloped of the Embryo.

2. The mucous membrane, which lines the cavity of the *uterus*, is a continuation of that of the *Vagina*, but very thin, and firmly attached, beset with numerous mucous follicles, which, when filled, resemble vesicles (*vesiculæ s. ovula Nabothi*), and, in consequence of their capillary vascular rete, have a red appearance. In the neck it is whiter, thicker, and presents on the anterior and posterior wall longitudinal folds, which, from their conjoined trans-

verse folds, look like a palm leaf (*plicæ palmatæ, arbor vitæ uteri*), and after one pregnancy (not always) disappear.

3. The serous coat. The external surface of the *uterus* is covered by peritoneum, in front as far as the commencement, behind deeper downwards, to the middle of the *collum*, which, from the urinary bladder to the *uterus*, forms *ligg. vesico-uterina*, and, passing from this over upon the rectum, it forms *ligg. recto-uterina*. On the sides of the *Uterus* the peritoneum forms two folds:

The broad ligaments of the *uterus*, *ligg. uteri lata*, which pass transversely from the internal surface of the external pelvic wall (at the pelvic inlet) to the *Uterus*, and each (of the two) consists of two layers, between which are situated at the superior free border the *tuba*; under that the *lig. ovarii*; and behind that the *ovarium* itself, whereby an expansion like a bat's wing arises, *ala vesperilionis*. Before the broad ligaments an actual fibrous band lies on either lateral border of the *uterus*:

Lig. uteri rotundum s. *crus uteri*, round ligament of the uterus, which goes off from the *uterus* close under the *tuba*, consists, like this, of muscular tissue, and is placed in a particular fold of the anterior layer of *lig. uteri latum*; ascends externally to the internal inguinal ring, then passes forwards and downwards through the inguinal canal, covered by a serous sheath and muscular fibres (like *m. cremaster*), to the *mons veneris*. It serves for the fixation of the uterus (and, from its large supply of blood, to conduct it to this organ).

Vessels: *Art. uterinæ* are branches of *hypogast.* or *umbilicalis*; pass in a very serpentine course, and often anastomose with *spermatica intern.* Veins: *plex. uterini* open into the *vv. uterinæ* and *spermaticæ*; they form *sinuses* in the substance of the mucous membrane. Lymphatics; very numerous and strong, especially upon the surface; passing between the *lig. lata*, they open into the *plex. hypogastric.*

Nerves: branches of *plex. hypogastricus superior* (of *sympathic.*), and *lateralis* (of *sympath.* and *sacral* nerves); they enter the substance of the *Uterus*.

• Function of the *Uterus*: 1. Formation of the embryo. 2. Separation of the menstrual blood [probably from veins].

487.

4. The *Vagina*,

a membranous cylinder from three to seven inches long, one inch wide, flattened and curved from behind forwards, is situated between the *bladder* and *rectum*, *vulva* and *uterus*, and forms with the last a concave angle forwards.

The superior, widest portion, *fundus* s. *fornix vaginæ*, surrounds, intimately united to it, the vaginal portion of the neck of the *Uterus*. The inferior, narrow extremity, surrounded by *m. constrictor vaginæ*, forms the entrance to the *Vagina*, *introitus vaginæ*, which is partly closed by a crescentic fold of mucous membrane lying at the inferior border (the membrane of the virgin, *Hymen*). (As the remains of the *Hymen*, torn during copulation, we observe two to five small lobules, the so-called, *carunculæ myrtiformes*; according to Lauth they are, however, present close to the *Hymen*. The *Hymen* is sometimes found, notwithstanding the performance of coitus; but it is sometimes wanting even in the newly-born). The anterior wall rather concave, shorter than

the posterior, is placed behind the urethra and the base of the bladder, which are firmly united with it. The posterior wall, above convex, below concave, about half an inch longer, abuts upon the *rectum*. At the sides, the *ligg. lata* are attached above, the *fasc. pelvis* and *m. levator*, below.

Structure. The *vagina* consists of a spongy, erectile, very vascular tissue (like *corpp. cavernosa*), which is enclosed by an external very dense and strong, and an internal less thick fibrous coat. The internal surface is lined by a firmly attached reddish mucous membrane, through the thick *Epithelium* of which numerous mucous *follicles* and *villi* are distinguishable. Transverse columnar folds are placed on both sides of the middle line on the anterior and posterior wall, these are *columna rugarum*, *anterior* and *posterior*. They disappear at the superior part after delivery.—The serous membrane (*peritoneum*) at the posterior uppermost part.

Vessels: *Artt. vaginales*, branches of the *hypogastrica*, the *uterina*, *vesicales*. Veins: *plexus vaginalis* upon the anterior and posterior wall (containing frequently *phlebolithes*).

Nerves: Branches of *plex. hypogastric. lateralis* (of *sympathicus*; 3—4. Sacral nerves).

488.

5. The *Vulva*,

lies in the *regio pubis* under the mons Veneris, about an inch before the *orificium ani*, and consists of the large and small pudendal lips, the *clitoris* and the *vestibule*.

a. The great or external lips, *labia pudendi majora*, the parallel folds of skin, passing from above downwards and behind forwards, which are beset with hair and cushioned with fat (like mons Veneris), which cover the rest of the pudendal parts, have a longitudinal fissure, "*rimæ vulvæ*," between them. The superior angle is designated *commissura anterior*, the inferior *c. posterior*. At the inferior commissura a thin membranous fold, *frenulum labiorum*, which in delivery is generally torn; and the space between the *frenulum* and the *Hymen*, the *fossa navicularis*. The internal surface is smooth, like mucous membrane, and passes into the internal lips.

Arter.: *labiales post.* (of *pudenda intern.*); *labial. anterr.* (of *pudenda extern.*)

Nerves: from *ileo-hypogastric.*, *spermatic.* from the inguinal canal.

b. The internal or small pudendal lips, *l. p. minora* s. *nymphæ*, the narrow folds of mucous membrane on the internal surface of the great lips, having the vestibule between them. Above they become broader and divide into two rami, the superior of which blends, above the *clitoris*, with the *præputium clitoridis*, the inferior, losing itself in the clitoris, forms the *frenulum clitoridis*. Between the layers of the fold an erectile tissue is found [which presents an enlargement below; in fact corresponds to, and is of the same structure as the bulb of the *Corp. Spongiosum* of the

male. TRANS.] At birth the internal lips are larger than the external; in women who have frequently given birth to children, and are thin [even during pregnancy], they project out beyond the great lips; in the Hottentot women they form the so-called "aprons."

c. The *Clitoris*—an erectile organ, like the *corpus cavernosum penis*—lying close under the anterior commissure between the great lips, surrounded by fat and a fibrous sheath. Commonly one inch long, three lines thick, it often becomes much larger, and then might be taken for a *penis*, (but it is not perforated by the urethra, and the *corp. spongiosum urethræ* is wanting in it). It arises with two roots, from the *ram. adscendent. oss. ischii*, which are united below the *symphysis pubes*, and thus terminated, a few lines before the *symphysis*, with a roundish extremity, *glans clitoridis*; *prepuce* and *frenulum* exist. *Lig. suspensorium* and *Mm. ischio-cavernosi*, as in the *penis*. *M. constrictor vaginæ* (this corresponds with *m. bulbo-cavernosus penis*). Arter.: *profunda* and *dorsal. clitorid.* from *pudenda interna*.

d. The vestibule, *vestibulum Vaginæ*, that is, the floor of the pudendal fissure, between the *clitoris* and the inferior commissure; bounded laterally by the nymphæ. A superior opening is found therein, the *orificium urethræ*, one inch [less] under the *clitoris*, surrounded by a slight elevation and radiating folds; and lower down the entrance to the *Vagina*. Mucous follicles are found, particularly in the region of the orifice of the urethra; sebaceous glands, which secrete a caseous substance of a peculiar smell upon the *nymphæ*.

e. *Glandulæ Bartholinianæ*, (again made known by Tiedemann in 1840) s. *Duverneianæ* s. *Cowperi*, two flat, almost bean shaped, reddish white, hardish glands; of five to ten lines long, lie in a considerable quantity of fat, at the sides of *introitus vaginæ* (one on either side) beneath the external skin of the inferior part of *labia majora* and fill up the space, between the extremity of the *vagina*, *ram. ascend. ischii* and *crura* and *erector clitoridis*, before the *m. transvers. perinæi*.

Structure. The glands consist of small, flat rounded, and conglomerate lobules, in which arises a membranous excretory duct, from cæcal vesicles, eight lines long, which passes out at the anterior border of the superior part of the glands, before *m. constrictor vaginæ*, passes behind the *labia majora* horizontally, inwards and forwards, and opens with a wider orifice at the sides of the *vestibulum Vaginæ*.

Arteries: these are branches of *pudenda interna* and *vaginales*.

Nerves: delicate twigs of *n. pudendus*.

489. 6. The breasts, mammary glands, *mammæ*, are two semi-globular or conical (in Spanish women) glands on

the anterior surface of the Thorax (before the third to the sixth ribs) covered with fat and a delicate smooth skin, in the centre of which rises the conical teat, or nipple, *papilla mamma*, surrounded by a rosy or brownish halo, *areola*. The bosom, *sinus*, is the space between the two mammæ.

Structure. The gland, freed from fat, is flattish, round, and rests upon the *m. pectoral maj.*, with its flat base, separated by *fasc. superficialis*. The surface is irregular, because the gland chiefly consists of irregular lobules, which are associated together by uniting and adipose tissue, but do not communicate with one another. [They are placed in a fibrous tisse, a kind of *proper fascia*, pointed out by Sir Astley Cooper, in his work on the Breast. TRANS.] The lobules again consist of roundish vesicles arranged together, like a bunch of grapes (*acini, cellulae, vesiculae*), the white excretory ducts of which unite together to form a large milk duct, *ductus lactiferi*, of which twelve to twenty finally remain passing inwards towards the central point of the gland, and open in the nipple, between the wrinkles of the skin, either singly, or two or three united together.

The vesicles consist of fibrous tissue, which also unites the lobules and gives to the gland its firmness. The milk ducts are surrounded by erectile tissue both in the *areola*, where they form enlargements, and in the *nipple* itself, in consequence of which the nipple in suckling, or from physical causes, becomes erect.

In the male breast the vesicles and ducts are wanting.

Vessels: Branches of *artt. mammae externæ*, very strong during suckling. Veins: *circulus venosus areolæ*; they open into *Vv. mammar. extern.* Lymphatics: they enter the *axillary glands* and *plex. mammarius*.

Nerves: Branches of *nn. supraclaviculares* from the *fourth cervical nerve* to the skin; very delicate twigs probably enter the gland with the arteries. [Filaments of *nervi intercostales*.]

OF THE SENSES.

ORGANA SENSORIA.

“ We observe in the eye many exquisite refinements of construction, by which various defects, unavoidable in all optical instruments of human workmanship, are remedied. Of this nature are those which render the organ achromatic, which correct the spherical aberration, and which provide for the adjustment of its refracting powers to the different distances of the objects viewed; not to speak of all the external apparatus for the protection, the preservation, and the movements of the eyeball, and for contributing in every way to the proper performance of its office. Are not all these irrefragable proofs of the continuity of the same design; and are they not calculated still farther to exalt our ideas of the Divine Intelligence, of the elaborate perfection impressed upon His works, and of the comprehensive views of His providence ?”—ROGET. *Bridgewater Treatise*, vol. i. p. 32.

OF THE SENSES.

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OF THE SENSES, *ORGANA SENSORIA*.490. 1. The organ of Sight, the Eye, *Organon visus, oculus*.

The eye is placed in the orbit (see Osteology), and is moved, for the complete performance of its functions, by six proper muscles, (see Myology), protected by certain contrivances, and by others maintained in a lubricated state.

A. Accessory Organs, *Tutamina oculi*.491. 1. The eyebrows, *supercilia*,

two arched enlargements of the skin along the superior border of the basis of the orbits, are beset with short, stiff hairs, directed towards the temples, which are arranged more closely, inwards towards the nose, and are, rarely only, continued over the root of the nose (by *intercilia*). The skin is thick, lies firmly upon a muscular layer of *m. frontalis*, *orbicular*. and *superciliaris*; is provided with numerous nerves from *n. facialis* and *trigeminus*, and with vessels from *ophthalmicus* and *temporalis*. Uses: The eyebrows protect the eyes against too strong light, and from the perspiration flowing down from the forehead; they serve, besides, for the expression of the face.

492. 2. The eyelids, *palpebræ*,

two movable cutaneous curtains, which, passing off from the superior and inferior border of the base of the orbits completely shut up the eye when they are approximated. They consist of skin, muscular fibres, cartilage and mucous membrane. The anterior or cutaneous surface is convex, and folded across; the posterior surface turned towards the globe of the eye, concave and beset with yellowish, vertical lines (*glandul. Meibom.*). The free borders are in the open eye curvilinear, and they bound an elliptical space, in the closed eye rectilinear, and only leave a narrow fissure, *rima palpebrar.*, but not a triangular canal between them. The anterior edge of the free borders is beset with three rows of short, stiff and curved hairs, *cilia*, eyelashes, the points of which diverge from one another; the posterior edge presents a regular row of (twenty-five to thirty) small openings (see Meibomian Glands, § 493.) At the last [internal] one-sixth of the free border, it presents a tubercle provided with an opening, the *lacrymal punctum*. From this point inwards there are neither *cilia* nor openings any longer

present. The free borders unite together, and form towards the temples the external acute angle, *commissura externa s. canthus minor*, which leads into a depression (of the *conjunctiva*); towards the nose (at the posterior border of *proc. ascendens maxill. super.*), the internal rounded and wider angle, *commissura interna s. canthus major*. The superior eyelid is deeper than the inferior.

a. The cartilages of the eyelids, *tarsi*, tarsal cartilages, are thin fibro-cartilaginous plates, which are placed towards the free border of the eyelids; the superior four, the inferior two lines, deep. Their anterior convex surface is covered by *m. orbicularis*; the posterior is firmly united with the *conjunctiva*; the free border is thick, the attached thin, in the superior eyelid convex (here is affixed the *m. levator palpebr. super.*), and it continues into a fibrous membrane, which externally, very strong at the *basis orbitæ*, internally loses itself in uniting tissue.

The two *tarsi* do not reach to the angles of the eye, but become united to them by the tarsal ligaments:

Lig. palpebrale internum, a flat ligament, with its surfaces directed upwards and downwards, its borders forwards and backwards, which passes away transversely inwards, before the lacrymal sac, to the place where the frontal and superior maxillary bones (*proc. frontalis*.) unite together; and

Lig. palpebrale externum, which passes off from the external extremity of the *tarsi* (in a forked manner) protected by fibrous tissue, passes to the *proc. frontal.* of the malar bone inside the orbit, and is attached to its external angle.

b. The external skin of the eyelids is thin, rather transparent, attached by loose but fatless uniting tissue to the pale internal portion of *m. orbicularis*, connected firmly with the *tarsi*, and passes over on the free border of the eyelids into

c. The uniting membrane of the eyelids, *conjunctiva palpebrarum*. It is a soft, mucous membrane, covered with epithelium, provided with nerves and vessels, which covers the free border and the posterior surface of the eyelids, is reflected at the margins of the orbits from the lids upon the globe, forms at the external angle of the eye a depression, at the internal (where is the so-called *lacus lacrymalis*) a semilunar fold, concave towards the temples; this is, *plica semilunaris* (*memb. nictitans*, of animals). On the globe of the eye, the anterior third of which it covers, the *conjunctiva* is only loosely connected with the *sclerotica*, but the more intimately with the *cornea*. It enters into the lacrymal canals at the puncta, and lines them.

Vessels and nerves of the eyelids. *Artt. palpebrales* (*interna et externa*) are branches of *art. ophthalmica, temporalis, infraorbitalis* and *facialis*; they form an *arcus palpebralis* (*s. tarseus*) *superior* and *inferior*. The veins of the same name open into *Vv. angularis* and *temporalis* (*facial. anter. and posterior*). *Conjunct. palpebrar.* is plentifully supplied with blood vessels, less so the *conj. sclerotica*, not at all the *conj. cornea*, in which Arnold has found Lymphatics.

Nerves: they are branches of *trigeminus* (*frontal.*, *lacrymal.*, *infraorbital.*, *infratrochlearis*); *facialis* (to *m. orbicular.*); *oculomotorius* (to *levat. palpebrar.*)

493.

The glands of the eyelids.

a. The glands of Meibomius, *gl. Meibomianæ*, lie in the substance of the tarsal cartilages (twenty to twenty-five in the inferior, thirty in the superior), are rather lower than the last, and open on the posterior edge of the free border of the lid, in a row. Each gland consists of a convoluted tube, the walls of which are cellular all round, so that it looks like a bunch composed of berries united together without stalks, is formed of uniting tissue, filled with flat cells and fat vesicles, and pours out a viscous fluid which prevents the overflow of the tears (*lema*). The short excretory duct of one gland sometimes unites with that of another, or is fissured.

b. *Caruncula lacrymalis*, is a flesh-like corpuscle, the size of a grain of rye at the *internal canthus*, internal to *plica semilunaris*, covered by the *conjunctiva*; it consists of an assemblage of glandules of the same kind as the Meibomian, from which (seven or eight) minute openings proceed, and upon which light, short, small hairs are seen.

494. 4. The lacrymal organs, *organa lacrymalia*.

a. The lacrymal gland, *glandula lacrymalis (innominata)*, consists of two parts, both of which are situated above the *external canthus*.

The superior or orbital portion, of the size of an oat grain, lies transversely with the superior convex surface attached to the *fovea lacrymal.* of the frontal bone, with the inferior concave surface upon *m. rectus externus*; its anterior border close behind the superior external border of the orbit, and the upper lid; on its posterior border nerves and vessels enter.

The inferior or palpebral portion is smaller, thinner, situated, covered by a fibrous membrane, upon the external side of the upper lid, and reaches downwards almost to the superior border of the *tarsus superior*. The ten or twelve excretory ducts of both parts open (almost invisibly) on the posterior surface of the upper lid, one line above the cartilage, from the external angle as far as the centre of the lid, in a row, and perforate the conjunctiva. Arter.: *art. lacrymalis*. Nerves: a branch of *sympathicus*; *n. lacrymal.* (*trigemin.*) passes, nominally only, through it to the conjunctiva, like *n. facialis* in the *Parotis*.

b. The puncta and lacrymal canals. The circular, constantly open *punctum lacrymali*, is found at the apex of a small tubercle (*papilla lacrymalis*) on the internal part of the free border of the eyelid. The superior looks downwards and backwards, the inferior upwards and backwards towards the globe. Both lead into the lacrymal canaliculi, *canaliculi lacrymales s. cornua limacum*. They pass at the commencement vertically, immediately bend at a right angle, inside the free border of the eyelids, inwards and open, inde-

pendently, in the anterior external part of the lacrymal sac, behind *lig. palpebrale internum*. The commencement is somewhat wider than the remaining part, in the whole a capillary tubule; the walls thick and elastic, covered before by fibres of *m. orbicularis*, behind by fibres of *m. Horneri*, consist of mucous membrane.

Musc. Horneri [*tensor tarsi*] arises from the *crista lacrymalis*, passes transversely outwards, is divided by *lig. palpebr. intern.*, and attaches itself to the internal angle of the eye, drawing the lids inwards, and making the puncta deeper in the *lacus lacrymalis*, where they take up the lacrymal moisture and carry it into

c. The lacrymal sac and duct. These two form one canal (*canalis lacrymalis oss. unguis*), which extends from the eye as far as the nose; secretes a mucous fluid, and carries this, together with the tears, into the nose. The lacrymal sac, *saccus lacrymal.*, an oblong but closed sac, formed of soft, reddish mucous membrane, united by areolar tissue on the inner side with the *fossa lacrymal.* (*os unguis* and *proc. nasalis* of the upper jaw) on the external with a fibrous continuation of *m. orbicularis*; it lies, close behind the internal inferior angle of *basis orbitæ*, behind and under the *lig. palpebrale intern.*, above which the cæcal extremity of the sac, only, projects a little upwards. On the external surface is placed *m. Horneri*. The lacrymal canaliculi open close behind *lig. palpebr.* Below it continues into the

Lacrymal duct, *ductus (naso-) lacrymalis* a membranous canal flattened on the sides, somewhat contracted in the centre, which, slightly curved forwards and outwards, descends in the osseous *canalis lacrymalis* to the nasal cavity, and opens into the inferior nasal chamber below the anterior part of the inferior turbinate bone (sometimes in a fold of mucous membrane which elongates the ducts a few lines). Internally it lies on the *meatus narium* and *concha inferior*; externally on the thin wall of the *antrum Highmori*. Arter.: branches of *ophthalmica*. Nerves: *infra-* and *supra-trochlearis* (*nerv. ophthalmici*).

495.

5. The muscles of the eyes.

These are placed together inside the orbits, in the depth of which they arise and form a circle around the *N. opticus* and the nerves of motion.

a. *M. lev. palpeb. superioris* (see Myologia).

b. *Mm. recti bulbi oculi*, the four straight muscles of the eye.

Origins: round about the *foramen opticum*. Insertions: with a broader aponeurosis to the *Sclerotica*, convex towards the *Cornea* and in its proximity. Position: one surface turned towards the walls of the orbit, the other towards the optic nerve and the globe of the eye; separated from these by adipose tissue and vessels; in a straight direction from behind forwards, curved on the globe. The opening in the capsule for *rect. intern.* is rather higher than the internal, for *rect. extern.* on the same plane with the external angle of the

eye, for *rect. super.* and *infer.* rather inwards of the vertical diameter (Wilbrand). Use: each draws the globe towards its own side; associated they draw it inwards, with the exception of the *rect. extern.* [The *rect. externus* has two origins, one as stated, the second from the margin of the spheroidal fissure.]

Rectus superior s. *superbus* is the weakest; *rect. inferior* s. *humilis*: *rect. internus* s. *amatorius* s. *bibitorius*, the shortest and thickest; *rectus externus* s. *indignatorius*, antagonist of the two *obliqui*, the longest, is alone provided by *nerv. abducens*, the others by *N. oculo-motorius*.

c. *M. obliquus superior* s. *trochlearis* s. *patheticus*.

Or.: between *m. rectus sup.* and *intern.* before the *foram. opticum*, from the body of the Sphenoid bone. Ins.: at the superior part of the *Sclerotica*; four lines broad, behind *musc. rect. super.* Figure: elongated, fusiform; the tendon curves backwards, downwards, and outwards. Position: at the superior, internal angle of the orbits; the tendon passes in the *trochlea* [a small cartilage, five-sixths of a small ring] through a tendinous sheath. It is alone provided by *nerv. trochlearis*. Use: to roll the globe inwards and downwards.

d. *M. obliquus inferior* s. *minor*.

Or.: *os maxilar super.*, between *margo infer. orbitæ* [sometimes from it] and *canal. lacrymal.*; often from the lacrymal sac. Ins.: the posterior external part of *Sclerotic*, six lines distant from the *cornea*, three from the optic nerve, behind the attachment of *rectus externus*. Pos.: flat under the globe of the eye (externally, above and behind) between the floor of the orbit and *m. rectus inferior*, enveloped in fat. Use: to roll the *bulbus* outwards and upwards. Both *musc. obliqui* draw the globe forwards [?].

496. B. The Globe of the Eye, *Bulbus oculi*,

an oblong globe formed of three circular membranous layers lying over one another, which are filled with a transparent refracting apparatus, being surrounded by the capsule of the eye and an elastic cushion of adipose tissue in the anterior parts of the orbits, and projecting outwards at the external border of the basis beyond it. Its longitudinal diameter is about one line longer (eleven lines) than the transverse, as the anterior segment of the globe formed by the *cornea* projects before that composed of the *Sclerotica*.

Capsula bulbi oculi (Bonnet and Ferrall),

a strong, fibrous membrane, firmly applied behind to the globe, and passing, becoming thinner in its course, into the fibrous sheath of the *Optic* nerve, before into the *Perichondrium* of the *tarsi* of both eyelids. All the muscles of the globe lie behind and perforate it

with their anterior extremities, in order to attach themselves to the *Sclerotica*; so that, in consequence of the thickness and strength of the capsule, each passes away, as it were, over a trochlea.

a. The most external of the coats of the eye. They determine the shape of the organ. They are the stiff *Sclerotica* and the transparent *cornea*.

497. 1. *Sclerotica* (s. *tunica albuginea* s. *cornea opaca*), the white coat.

a strong, opaque membrane, forms a segment of a sphere, the anterior sixth of which is represented by the transparent *cornea*. It consists of short fibrous fasciculi interlacing with each other in every direction, is bluish, brilliant (inwardly brown), provided with few vessels, and not at all with nerves. [?] Rigid, and not extensible, it is thinnest anteriorly in the neighbourhood of the *Cornea*, behind, where a foramen for the Optic nerve perforates it, thickest. The foramen for the optic nerve lies rather internally to the axis of the globe. The external surface of the *Sclerotica* is covered before by the *conjunctiva* connected with it by loose uniting tissue, and by the tendons of the muscles of the globe. The internal surface is wrinkled, brown, and connected by delicate uniting tissue and the obliquely passing ciliary vessels with the *tun. Choroidæa*. The ciliary nerves pass from behind forwards between the two coats.

The anterior border is circular, bevelled off on the internal surface obliquely backwards (*sulcus Scleroticæ*), for the reception of the corresponding bevelled border of the *Cornea*. Both are firmly united together. Between them and the *ligam. ciliare*, which is here, also, attached, we find (in animals)

sinus circularis venosus iridis s. *canalis Fontanæ*, a very narrow circular canal which receives the veins and the blood of the *iris*, which is driven out from these during enlargement of the pupil, and is said to give off *vv. ciliares anticæ*; but in Man it is placed in the substance of the *Cornea* (as *canalis Schlemmii*).

The *Scleroticæ* is to be considered as a continuation of the *dura Mater* upon the Optic nerve; [?] the *pia mater* and *arachnoidea* do not pass into the eye. At the foramen for *n. opticus* a *lamina cribrosa* was formerly described, that is, a perforated plate which apparently arises from the manner in which the neurilemma leaves the fasciculi of the *n. Opticus* at this place.

Vessels: a few arteries from *artt. ciliares*; Veins more numerous, in connexion with the canals of the *Cornea*; Lymphatics are probably present. Nerves not yet demonstrated.

498. 2. (*Tunica*) *Cornea*, the transparent Cornea,

is a thick, transparent, strong, but elastic membrane, forming the segment of a smaller (also more convex) sphere than the *Sclerotic*, and the anterior part of the *bulbus*. Its anterior convex surface is covered by *Epithelium*, a conti-

uation of that of the *conjunctiva* (this is the firmly applied *conjunctiva cornea*); the posterior concave surface forms the anterior wall of the anterior chamber of the eye; its posterior border, bevelled obliquely on the external surface, is extremely firmly united with the *Sclerotica*. (According to Valentin, both membranes grasp one another by indentations of looped and reflected fibres.)

The *cornea* consists of four layers:

a. *Epithelium* on the anterior surface, forms after death a slimy covering, which makes the cornea appear opaque (*conjunctiva cornea*).

b. The proper *cornea* is laminated, and consists of flat cell fibres which interlace in all directions, becoming in boiling water a white jelly and dissolved.

c. The membrana *Demoursii* s. *Descemetii*, a firm cartilaginous, colourless, and transparent thin membrane, which remains unchanged in boiling water; does not pass over upon the *Iris*, but passes over to its external border and terminates between *sclerotica* and *lig. ciliare* with a sharp border.

d. The pavement Epithelium on the posterior surface of the Demoursian membrane reaches only as far as the external border of the *Iris*, and looks into the anterior chamber of the eye (this is the so-called *membr. humoris aquei*). The cornea is nourished mediately only, by the aqueous humour with which it is saturated. In the fœtus a capillary rete is found under the anterior epithelium, the branches of which come from the vessels of the *conjunctiva sclerotica*; in the adult the

Canalis Schlemmii (see before, § 497), near to the border of the cornea, is said to be a venous sinus, but it receives no branches from the cornea.

The layers, a, c, and d, possess no vessels; in the inflammatory condition of the eye such may be regarded as but only newly formed. Nerves: (discovered by Schlemm in the eyes of animals) arise from the ciliary nerves on the *sclerotica*, and are lost at the border of the *cornea*;—Pappenheim has followed them between the lamellæ.

The *cornea* is more convex and thicker in the embryo and the newly born than in the adult. Impinging rays of light passing through it become refracted in a converging direction.

Weber has classed the cornea with the Epidermic formations. According to Arnold its substance passes immediately into that of the (fibrous) *Sclerotica*, and it bears all the characters of a serous membrane, as: transparency, secretion of serum, vascular canals, formation of bloodvessels, regeneration; the laminated structure is only an artificial production.

Arnold admits of a second layer between *sclerotica* and *choroidea*; this is the

Arachnoidea oculi, which is said to form a closed serous sac, and has been already observed by Zinn, Wardrop, and others, the external portion of which has been designated *lamina fusca sclerotica*, the internal *membr. suprachoroidea*. Cases of a morbid collection of fluid (by Riolan, Weller, Scarpa) are said to support this acceptation. According to

Henle it does not exist; but there is only to be found in this situation a loose, delicate, uniting tissue with pigment cells.

b. The central, vascular, and coloured layer of the coats of the eye.

499.

3. *Choroidea s. tunica vasculosa*,

a thin, very vascular tunic of the same extent as the *sclerotica*, to the internal surface of which it is attached by a delicate, brown, uniting tissue (see *Arach. oculi*). Both surfaces, but especially the internal, on which the *Retina* lies, are covered by a deposit of black pigment which consists of mosaic-like, angular, or roundish cells, and is provided with innumerable convoluted longitudinal striæ which correspond to vessels. What has been described as *lamina fusca sclerotica*, is probably identical with the pigment deposit on the external surface of the choroid. Behind, this membrane is perforated by a circular foramen for the passage of the optic nerve. The choroid has been artificially divided into an external (venous) layer, and an internal (arterial, *membran. Ruyschiana*); of which we may assume the former to form the *ligam. ciliare*, the latter the *corpus ciliare*. Vessels: *artt. ciliares post.* upon the internal surface; *vasa vorticosa* (veins) upon the external surface, pass into *vv. ciliar. postt.* Nerves; a few ramify in it, most pass through it. (Pappenheim.)

a. *Ligamentum ciliare s. orbicularis ciliaris*, the ciliary ligament, a flat, gray and delicate circle, from a line to a line and a half broad, the anterior, smaller and thicker border of which abuts on the point of junction of the *cornea* and *sclerotica* and unites with the external border of the *iris*, whilst the posterior, thinner, and larger border meets the *corpus ciliare*, and receives the ciliary nerves which divide in the ciliary ligament, going through it (Arnold) or ramifying in it (Pappenheim). Its external surface lies loosely on the anterior part of the interior of the *sclerotica*. A vascular rete with large meshes in it, is connected behind with that of the *choroid*, and passes anteriorly into the iris.

b. *Corpus ciliare*, the ciliary body, the internal lamina of the anterior border of the *choroid*, reaches farther backwards than a, is sharply bounded by a toothed edge from the proper *choroid*, but which belongs to the *zonula Zinnii*, turns up from the posterior body of the *lig. ciliare* inwards to the border of the lens, and forms a flat circle which consists of the

Processus ciliares,—seventy to eighty short folds. These become larger from behind forwards, and they converge; in the intervals between them corresponding folds of the *zonula Zinnii* are placed, whereby both are firmly united with one another, and the ciliary body with the capsule of the lens; deprived of the pigment layer in their depressions, they appear white. It is said that a circle of (muscular) fibres extends from their free circumference as far as the capsule of the lens; this is

Ammon's orbiculus capsulo-ciliaris, but which belongs to the *zonula Zinnii*. A proper *membrana pigmenti* is even admitted by some, which separates the pigment layer on the posterior surface of the *choroid* from the *Retina*, is re-

flected at the capsule of the lens over and upon the posterior surface of the *iris*, to terminate at the margin of the pupil.

The pigment is so much the darker, the farther it lies internally ; it is sometimes entirely wanting (in Albinos); it sometimes presents deposits of salts (the so-called ossifications). In ruminants, also the dog and cat, remarkably brilliant, it is called *tapetum*.

500.

4. The *Iris*,

a thin disc-shaped membrane, becoming thicker from without inwards, consisting of contractile tissue, forms a vertical septum, perforated by a foramen, between the anterior and posterior chambers of the eye. The foramen (*pupilla*) is not placed quite in the centre, but rather to the inner side, is bounded by the internal or free border of the *Iris*, is dilated or contracted according as the last contracts or relaxes, and is closed in the fœtus by the *membrana pupillaris*. The external, larger (ciliary) border of the *Iris* is loosely attached to the *lig. ciliare* which on the anterior surface, and to the *proc. ciliares*, which on the posterior surface project rather over it. The anterior surface of the *Iris* is flat, speckled (blue, brown, &c.), striated, and forms the posterior wall of the anterior chamber of the eye. Towards the pupillary margin the colour is deeper than in the remaining two-thirds; we therefore distinguish a *zona iridis minor* and *major*. The striæ pass from the external towards the inner margin, converge and cross each other; they are in the contracted pupil straight, in the dilated wavy, like the vessels through which they arise.

The posterior surface is covered with a thick layer of black pigment, on the ciliary border by the *proc. ciliares*, and folded; denuded of pigment, it is white and smooth, like the *Choroid*, which, besides, is far thinner than the *Iris*.

Structure. The *Iris* probably consists of contractile uniting tissue, according to the older, now also the opinion supported by Valentin, of simple muscular fibres, which pass like a sphincter on the pupillary margin. (In the ox there are distinct circular fibres.)

Vessels and Nerves: *Art. ciliares anticæ* and *posticæ longæ* (see *art. ophthal.*) form a *circulus arteriosus iridis major* on the ciliary border, from which arises a *circ. art. irid. minor.* on the pupillary margin.

Veins: like the arteries; some open into the *canalis Fontanæ*.

Nerves: *N. ciliares*, from *ganglion ciliare*, very numerous, pass through *lig. ciliare* into the *Iris*.

There was formerly distinguished an anterior lamina, the proper *Iris*, and a posterior, *uvea*.

c. The third layer of the coats of the globe of the eye.

501. The *Retina* s. *tunica nervea* the nervous coat,

a soft, yellowish white membrane, which is placed concentrically on the internal surface of the *Choroidea*, covered with pigment, consists of several layers, the most essential of which is a smooth expansion of the Optic nerve.

Its internal surface is applied loosely to the vitreous body; its anterior extremity reaches as far as the posterior border of *corpus ciliare* (according to the older view as far as the lens, before or behind the *zonula Zinnii*). At the posterior extremity, where the rather projecting optic nerve enters (medullary elevation), it presents in the axis of the eye, that is to say, on the external circumference of the optic nerve, a transparent spot (probably not perforated), the so-called

Foramen centrale retinae, hidden behind a yellow transverse fold, *macula lutea*. This last is found in man (and apes) only, and even here but for a time after birth. Its object is unknown.

Structure :

1. The external layer of the Retina, which is connected with Choroid, and is described as *Tunica Jacobi*, consists of the so-called rod-shaped corpuscles, that is to say, closed cylinders, which are soft, flexible, easily torn, filled with an oily material, and only loosely joined with one another.

2. The proper nervous layer arises from the manner in which the optic nerve sends out nerve tubules in bundles from its place of entrance in all directions, and forms long meshed plexus. Whether the nerve fibres terminate freely, or are reflected in loops (Valentin), is yet uncertain. Likewise, whether a proper (ganglion) globular layer exists on the internal nervous layer.

3. This lies immediately within a dark granular layer, in which the vessels pass, and which towards the vitreous body is bounded by a kind of large-celled epithelium (vascular layer of the *Retina*). This last passes over the *processus ciliares*, and extends over the *zonula Zinnii* as far as the capsule of the lens (whilst the nervous and cylindrical layers do not reach the *corp. ciliare*), and forms the so-called ciliary portion of the Retina (Henle). According to Bidder, the layer of cylindrical cells does not reach to the *zonula ciliaris*. His layer of ganglion globules (continuations of the gray substance) and the *stratum nerveum* (continuation of the white substance) reaches as far as the capsule of the lens. According to Langenbeck, jun., and Pappenheim, a sinus passes on the internal surface in the anterior border of the *retina*, *sinus s. circulus venosus retinae*.

[Art.: See Angiology, *Art. ophthalm.*]

Function of the Retina: it presents a susceptible nervous surface towards the light, the sensation of which is transmitted by the optic nerve to the cerebrum.

d. The transparent nucleus of the eye.

502. 1. *Humor aqueus*, the aqueous humour,

a transparent fluid, as clear as water, of spec. grav. 1.005, contains most water and only a little common salt and albumen, fills

up the anterior and posterior chambers of the eye, and is probably secreted by the *Iris* and the *corpus ciliare* (according to others by the vitreous body, &c.).

a. *Camera oculi anterior* is the space between *cornea* and *Iris*, measures in the longest diameter from before backwards about one line, is at its circumference encompassed by the anterior extremity of the *lig. ciliare*, and stands, through the pupillary aperture, in connexion with :

b. *Camera oculi posterior*, that is, the small (one-third of a line) space between the posterior wall of the *Iris* and the anterior surface of the *capsule* of the lens. The two chambers contain about five grains of fluid. The anterior chamber is, in the fœtus, shut out from the posterior by the pupillary membrane. An aqueous membrane which lines the two chambers as a closed sac, for which the *membr. Descemetii* is said to pass, is not to be found.

503. 2. *Lens crystallina*, the crystalline lens,

a round, biconvex, colourless, transparent body, is situated, narrowly enclosed by its capsule, behind the *pupilla*, at the boundary of the anterior fourth of the globe, and its axis in the axis of the pupil.

Its anterior surface is flatter, one line and a half distant from the *cornea* ; the posterior more convex, four lines distant from the fundus of the eye. Its margin is encompassed by the folds of the *zonula Zinnii*, and encircled by *canalis Petiti*.

Structure. The substance of the lens contained in the capsule becomes thicker from without inwards. The anterior portion, almost a thin fluid, the so-called *liquor Morgagni*, contains cells, like the gelatinous portion found behind it, with a very delicate membrane, which, when their water evaporates, become dark and granular. Upon the cellular layer narrow, straight fibres follow, which form layers, and lie close upon one another, like the scales of an onion, inwards towards the middle thickened into a nucleus (of a gummy consistency). Each lamina consists on the anterior surface of the lens of three, on the posterior of four triangles, between which a space in the form of a Δ or \cap remains, to which the fibres converge inwards, so that the lens breaks up into three to four (or more) wedge-shaped pieces by the action of an acid, boiling water, or even merely by heat.

The substance of the lens contains, more than the half, water, and much albumen, (Globulin according to Berzelius; Casein, Fr. Simon.); it becomes cloudy after death (whether by coagulation?), and coagulates in sulphuric and phosphoric acids, which last does not make it opaque.

The capsule of the lens, *capsula lentis*, a simple membrane, clear as water (under the microscope a faint yellow), in adults non-vascular, is smooth, strong, stiff, and distinctly thicker on the anterior wall than on the posterior. Its anterior wall looks freely into the posterior chamber of the eye, lies quite open when the pupil is widely dilated, and is firmly connected at the margin with *zonula Zinnii*; its posterior wall lies in the *fossa-hyaloidea* of the vitreous body.

It is rendered neither cloudy nor soluble either by boiling water, or by alcohol and acids. Of nerves it also possesses, like the lens, a few; and the vessels which it shows in a morbid condition are only developed in an abnormal manner. However, Walter has injected vessels on the posterior wall of the capsule.

The very vascular capsule of the lens in the Embryo (*membrana pupillaris*, and *capsulo-pupillaris*) is a closed, delicate membrane, formed of a capillary rete, which at the commencement closely surrounds the lens and its non-vascular capsule; but later, when the eye grows, it becomes smaller in proportion to the lens, and is applied to the Iris with its internal border; the anterior portion of the sac is removed from the lens and capsule, and now consists of two halves, namely, the piece which reaches from the border of the lens to the pupillary border of the Iris (*membr. capsulo-pupillaris*, J. Müller), and the piece which closes the pupil vertically (*membr. pupillaris*, Wachendorf). From the seventh month the vessels are obliterated (on the pupillary membrane from the centre towards the circumference), the membranes themselves disappear, and the *humor aqueus* is produced; in the *fossa hyaloidea* a few vessels appear to continue in existence.

504. 3. *Corpus vitreum*, the vitreous humour,

a globular, completely transparent body, which consists of a viscous fluid and a membrane (not anatomically demonstrable), filling up the posterior three-fourths of the globe of the eye, is surrounded by the *Retina*, and receives on its anterior surface, in a depression (*fossa hyaloidea*), the posterior surface of the lens. At the posterior boundary we find in the fœtus an infundibular-shaped fossa, *area Martegiani*, which arises from the *Art. capsularis*, passing in its canal, drawing upwards the vitreous body during the obliteration of its branches (or only arises after death, Arnold).

Humor vitreus, the vitreous humour, is colourless, and behaves, chemically, exactly like the *humor aqueus*. It is (probably) placed in cells of the vitreous membrane, which, by punctures, are individually emptied, but nevertheless, perhaps, communicate with each other. In the Embryo it is nourished by numerous vessels, of which, at a later period, the principal trunk only, passing to the *fossa hyaloidea*, *art. capsularis*, remains behind.

Membrana hyaloidea, the vitreous [or hyaloid] membrane, is only visible under the microscope; it is said to form the cells and the envelope of the whole vitreous body. This envelope is said to divide at the anterior boundary of the vitreous body into two laminæ, one of which passes behind the lens, and the other on its anterior surface, so that between the two the

Canalis Petiti, a triangular, circular, and closed canal, is formed, which surrounds the border of the capsule of the lens like a projecting fold, and probably contains fluid.

The anterior lamina, strengthened by a fibrous layer of *corpus ciliare* (on its posterior surface), forms the

Zonula Zinnii s. *corona ciliaris* (whether an independent structure or not is

still doubtful). It lies like a circlet of folds before the vitreous body, around the border of the lens, behind the *corpus ciliare*, and presents alternating black and clear rays. The rays are longer than the *proc. ciliares* of the choroid, and form depressions and folds which correspond to those of the last. Its posterior border is undulating and indented (*ora serrata*), and impinges upon the anterior boundary of the *Retina*; its anterior border is firmly connected to the border of the capsule of the lens (upon the anterior surface). The *corona ciliaris* in the fœtus is supplied plentifully with blood-vessels, which anastomose with those of the very vascular capsule and *Chorioidea*; but in the adult, like the hyaloid membrane, it is non-vascular.

505. II. The organ of Hearing. *Organon auditus*.

The ear, *auris*, consists of three parts. These are: The external, that is, the auricular cartilage and the external auditory meatus. The central, that is, the tympanic cavity and the Eustachian tube. The internal, that is, the Labyrinth.

A. The external part.

506. 1. The external ear, *auriculus*, the ear, an oval, elastic, cartilaginous plate, many times curved, situated on, and firmly attached by ligaments to, the lateral parietes of the head at an angle of from 25° to 30° , covered by the external integument. On its outer surface the following parts may be observed:

a. *Concha auris*, a hollow, the shape of a muscle shell, at the anterior and inferior part of which the external auditory canal commences, is bounded anteriorly by

1. *Tragus*, the anterior auricular valve, that is, a rounded, four-sided plate, internally beset with hairs, which can close the external auditory meatus in front.

2. *Antitragus*, a small triangular projection at the termination of the anthelix. It lies rather deeper, opposite to the *tragus*, and between the two we find:

incisura intertragica, a deeper and rounded excavation, above the lobule of the auricle. Above and behind, the concha is bounded by:

3. *Anthelix*, that is, a curvilinear elevation, which commences above the *antitragus*, passes upwards and forwards, and terminates with two crura (a sharp inferior and a blunt superior), between which is situated a shallow, triangular fossa, *fossa innominata*.

b. *Helix*, that is, the elevation which commences in the auditory concha, separates it into a superior and inferior portion, then, parallel with the *anthelix*, forms the external anterior reflected border of the auricle, and ceases at the auricular lobule.

Between *helix* and *anthelix* an oblong fossa, *fossa navicularis* s. *scapha* is

situated, extending from the superior extremity of the auricle, almost as far as the lobule.

The cartilage of the ear is elastic and flexible, covered with Perichondrium. The external integument which, particularly on the concha, is applied closely to it, is delicate and transparent, beset with *folliculi sebacei*, particularly in the concha and *fossa innominata*, with little hairs (*tragi*) upon the *tragus*. On the border of the *helix* it is applied more loosely, and forms at the inferior extremity a fold, the *lobule* of the auricle (*lobulus auriculæ*), between the layers of which we find a deposit of adipose tissue.

Ligaments:

a. *Lig. auriculæ posterius* is thick, and extends from the posterior parts of the *concha* to the superior of *proc. mastoideus*.

b. *Lig. anterius* s. *Valsalvæ*, triangular, broad, and strong, arises from a nodule on the *helix*, close above *tragus*, and even from this, and attaches itself to the root of *proc. zygomat. (oss. tempor.)*

Muscles. (For those moving the whole auricle, see Myology.) They should move the separate parts of the ear, but they are rudimentary; in savages, besides, not more strongly developed. The four first lie on the external surface of the auricle.

a. *M. heliciæ major*, narrow, about half an inch long, thin, at the arched superior and anterior part of the *Helix*, fibres vertical.

b. *M. heliciæ minor*, very small, at the arched inferior and posterior part.

c. *Tragicus*, three-cornered, tolerably thick, with vertical fibres; upon the *tragus*.

d. *Antitragicus*, narrow, short; passes from the *antitragus* to the *anthelix*.

e. *Transversus auriculæ*, transverse on the posterior surface of the ear, from the convexity of the *concha* to the external part of the *anthelix*.

f. *Dilatator conchæ* (Theile), from the anterior surface of the cartilaginous *meatus audit.* on the anterior inferior part of the *tragus*. Use: to draw the *tragus* forwards, and thus dilate the *concha*.

g. *Obliquus auriculæ* (Arnold), upon the internal surface of the ear, between the elevations of *fossa innominata* and the *concha*.

Vessels and nerves. Arteries: *art. auricularis posterior*; a branch perforates the *helix*, and enters into the *concha*; the rest curve round the edge of the former. *Art. auriculares anter.* from *temporalis*. Veins: they open into *V. facialis posterior*.

Nerves: *nn. auriculares anterior, superior, magnus* [to the skin (sensitive)]; *posterior* [to the muscles]; and a *ramus nerv. vagi*.

507. 2. The external auditory canal, *meatus auditorius externus*,

a semi-cartilaginous, semi-osseous canal, one inch long, is elliptical

in the transverse section, and passes from the base of the auditory *concha* horizontally to the *membrana tympani*, that is, from without inwards and from behind forwards. Close to the entrance it makes a bend, the curve upwards (whenever we wish to see to the end of the auditory passage, the centre of the auricle must be drawn upwards and backwards). The entrance is oval beset with hairs, bounded before by *tragus*, behind by the crescentic *crista* of the *concha*. The internal opening circular, directed obliquely from above downwards and from without inwards, and closed by the tympanic membrane. The narrowest place is found at the bend, the widest at the junction of the cartilaginous and osseous parts. Superior wall, ten lines, inferior, thirteen, posterior, ten and a half, anterior, twelve and one third long.

a. The osseous portion (seven to eight lines long) lies on the *basis oss. petrosi*, is in children made up by the *annulus tympani*, of which a groove remains behind (*sulcus tympani*), and which is interrupted at the superior boundary.

b. The cartilaginous portion (five lines long) is attached by fibrous uniting tissue with the toothed border of the osseous portion, forming, besides, the superior wall which is attached to the *proc. zygomaticus*. Its inferior longer wall is properly a continuation of the *tragus*, from which, by incomplete fissures (*incisuræ Santorini*), two C-shaped pieces are separated (like the *trachea*), which are approximated by interposed muscular fibres. The posterior wall is connected with the *Concha*.

The external integument, which is continued from the external ear upon the interior of the auditory passage, is always more delicate, proceeding inwards, is from the commencement beset with stiff, then with fine hairs and ceruminous glands (*gl. ceruminosæ*), and forms internally a closed cylinder, since it terminates upon the tympanic membrane. The glandules are numerous, especially in the centre (some thousands upon a square line.)

The cerumen is very bitter, partly soluble in water, containing a yellow oil, albumen, and salts of lactic acid. It becomes thickened by the evaporation of its watery elements.

Vessels: branches of *Art. auricular. poster.* and *profunda*.

Nerves: branches of *auricul. anter.* from *ram. 3 trigemini* and *auricul. n. vagi*.

508. 3. The drum of the ear, *membrana tympani*,

a thin, elliptical, semi-transparent and elastic membrane, four and a half lines in its vertical diameter, forming a partition between the cavity of the *tympanum* and the external auditory meatus, with the inferior wall of which it describes an angle of about 45°. Its external surface looks also obliquely outwards and downwards into the

auditory passage; its internal surface upwards and inwards into the cavity of the tympanum, and presents in the centre an elevation where the handle of the *Malleus* draws it inwards (on the external surface a funnel-shaped excavation). Its margin lies in the *sulcus tympani*; close to that, at the superior posterior part of the *membrana tympani*, the short process of the *malleus* presses the last outwards (*umbo*); at the posterior extremity of the horizontal diameter it is perforated by the *Chorda tympani*.

The *membrana tympani* consists of three laminae; the external is the sack-like extremity of the skin (*cutis* or *epidermis*) of the auditory passage; the internal is a prolongation of the thin mucous membrane of the tympanic cavity; the central the proper tympanic membrane, is very strong, fibrous (according to Ev. Home muscular), its fibres converge from the circumference towards the centre. The vessels appear to belong exclusively to the internal lamina. They form a close rete, *circul. vasor. major* and *minor* (as in the *Iris*).

Art. tympanica superior (from *stylomastoid*, s. *auricular. poster.*) and *inferior* (from *maxill. interna* or *externa*).

Nerves: *auricul. anterior* (*trigemini*.)

The *membrana tympani* is strained and vibrates feebly under strong, but is relaxed and vibrates strongly under feeble impressions produced by the undulations of sound.

B. The central part of the Ear.

509. 1. The cavity of the tympanum, *tympanum, cavitas tympani*,

an irregular, oblong, (four and a half lines) narrow (two lines) cavity, situated at the anterior part of the *basis oss. petrosi*, between the external auditory canal and the labyrinth. Anteriorly it is in connexion by the *tuba Eustachii* with the *Pharynx*, behind and above, where it is more spacious, with the cells of *proc. Mastoideus*.

Its external wall is formed by the osseous plate in which the *memb. tympani* is strained as well as by this itself; it is bounded before by *fissura Glaseri* (for *chorda tympani*, *art. tympan. infer.* and *lig. mallei anterioris*). The internal wall [*fundus*] lies opposite to the *memb. tympani*, and presents:

a. *Fenestra ovalis* s. *vestibuli*, an oblong opening, directed obliquely downwards and forwards ($1\frac{1}{2}$ line long), at the superior part of the internal wall, lying in a depression, bounded above by *canal. Fallopiæ*, below by *promontorium*, is closed by the footpiece of the *Stapes* and a thin membrane.—Under it,

b. *Promontorium* s. *tuber cochleæ*, an elevation which corresponds to one

turn of the *cochlea*, is covered with three grooves opening below into the *canal tympanicus*, and diverging upwards (for the anastomosis of Jacobson).

c. *Eminentia papillaris*, the pyramid, a small conical projection behind the *fenestra ovalis*; a fine orifice in its apex leads to a canal which passes away under *canal. Fallopiæ*, and is connected with it; this is *canalis stapedii*.

d. *Fenestra rotunda*, s. *cochleæ*, behind the promontory in a depression (which leads to the *vestibule*) is closed by a fibrous *membrana tympani secundaria*, and leads into the *Scala tympani* of the *Cochlea*.

At the anterior boundary the tympanic cavity contracts and runs out into two canals, the superior of which, *canalis tensoris tympani* (for *m. mallei internus*) is separated by a thin osseous lamella from the inferior canal, that is, the osseous *tuba Eustachii*, and is said to commence as a semi-canal (*semicanal.*) with a wide open-mouthed lamina, *proc. cochlearis*. Above and behind the great opening of the *sinus mastoideus* leads into the cells of *proc. mastoideus*. These cells are filled with air and covered with Epithelium. The superior boundary is vaulted, and the head of the *malleus* and of *incus* are situated in it.

510. 2. The Bones (ossicles) of the Ear, *Ossicula auditus*.

These are (three to four) movable osseous pieces, associated at angles into a chain, which are situated from without inwards between the *memb. tympani* and the *fenestra ovalis*.

a. The *malleus* lies immediately upon the *memb. tympani*. We observe on it, Head, neck, handle, and two processes.

1. *Head*, an oval, smooth enlargement, situated in the superior part of the tympanic cavity, above the *memb. tympani*, unites on its posterior concave surface with the *incus*, and is placed upon
2. *The neck*, a narrow piece inclined from before outwards, which passes into
3. *The handle (manubrium)*. This passes off from the neck at an obtuse angle, downwards and forwards, and terminates with a roundish point in the centre of the *memb. tympani* between the internal and central laminae.
4. *Processus brevis* s. *obtus* arises at the commencement of the *manubrium*, on the outer side, and presses the superior part of the *membr. tympani (umbo)* rather outwards in the ext. auditory meatus.
5. *Processus longus* (s. *folianus*) arises from the anterior part of the neck, long and thin, and enters into the *fissura Glaseri*, where *lig. mallei anterioris* is applied.

b. The *incus*, the anvil, like a molar tooth, is situated behind and below the *malleus*. Its body, that is, the most superior thick piece, has a concave articular surface directed forwards for *caput mallei*. Its shorter, superior process passes backwards, and attaches itself to the cells of the *proc. mastoideus*.

Its longer, thinner process, passes parallel with *manubrium mallei* internal to and behind it (*chorda tympani* between the two). On its hooked apex, which is bent backwards, we find the *ossiculum lenticulare Sylvii*, a tubercle, which is almost always united with the *incus*. It is situated freely in the tympanic cavity. From its apex passes inwards to the *fenestra ovalis*.

c. The Stirrup, *stapes*, horizontally, at a right angle. Its capitulum unites with the *ossicul. lenticulare*; from it passes off inwards an anterior and a posterior crus (on the concave surfaces of which, turned to one another, we find a groove, *sulcus stapedis*), which become associated by a thin plate, the foot piece (*basis stapedis*). This *basis* passes directly into the *fenestra ovalis*, in which it moves.

Muscles of the ossicula. Sümmering admits four muscles, three of which belong to the *malleus*, one to the *stapes*; distinct muscular tissue is, however, only found in the

M. tensor tympani s. mallei internus. Or.: from the superior wall of the cartilaginous *tuba Eustachii* and from the *Sphenoid* bone (behind *foram. spinosum*). Course: backwards in the osseous canal above the *tuba*, enters into the cavity of the *tympanum*, where the tendon is reflected at, almost, a right angle. Ins.: the anterior superior part of *manubr. mallei*. Use: to draw the *malleus* inwards, and stretch the *memb. tympani*.

To the ligaments of the ossicula belong therefore, besides the capsular ligaments between *malleus* and *incus*, and between *os lenticulare* and *stapes*:

1. *Lig. mallei capituli s. superius* passing from the superior wall of the *tympanum* to the head of the *malleus*.
2. *Lig. mallei manubrii s. posterius (laxator tympani minor)*; passing from the internal extremity of the auditory meatus, upwards and backwards, to the *manubrium*.
3. *Ligg. processus longi anterior s. mallei (laxator tympani major s. malleus externus)*, passes from *proc. spinos.* (of the sphenoid bone) through *fissura Glaseri* to the apex of *proc. folianus*.
4. *Lig. processus longi et brevis incudis* come from the posterior and external wall of the cavity of the *tympanum*.
5. *Lig. stapedis (muscul. stapedius)*; very thin; arises inside the *eminentia papillaris*, passes out of it into the *tympanum*, passes forwards and downwards, and is attached behind to the capitulum of the *stapes*; it is said to draw the *stapes* backwards, and thereby to press the posterior part of its *basis* deeper into the *fenestra ovalis*, whilst the anterior part is raised. The same thing happens when the *tensor tympani* draws the head of the *malleus* backwards, and imparts the movement to the remaining ossicula.

511. 3. The Trumpet of the Ear, *Tuba Eustachii*,

a straight canal, about two inches long, flattened at the sides, between the inferior anterior part of the *tympanum* and superior lateral part of the *pharynx*, passing in an oblique direction from

without inwards, from above downwards, and from behind forwards. It consists of an osseous and a cartilaginous portion, both of which are covered with mucous membrane, which at the *orificium pharyngeum* is thicker than in the remaining parts, and at the *orificium tympanicum* passes over into that of the *tympanum*. Both openings (about two lines broad) are wider than the rest of the canal (about one line broad).

a. The osseous *tuba*, seven to eight lines long, is situated in the angle between *pars mastoidea* and *petrosa* of the Temporal bone external to *canal. caroticus*, *vestibule* and *cochlea*, below the *canalis tensoris tympani*. To its rough border is attached:—

b. The cartilagino-membranous *tuba*, the internal half of which consists of cartilage, whilst the external wall is formed of a fibrous coat which is attached to the Sphenoid bone. It lies above the *fossa pterygoidea* at the inferior border of the *ala magna* of the Sphenoid bone. Its oval opening (four lines high, two broad) is tumefied, sloped, situated close behind and rather above the inferior nasal concha, at the superior part of the *pharynx*. The mucous membrane covering it is looser, very vascular, and beset with numerous mucous glands which are wanting in the osseous *tuba*. Through the *tuba* the external air obtains admission to the *tympanum*.

Vessels and nerves for the central part of the organ of hearing. Arteries: *Artt. tympanica*, *stylomastoidea*, farther branches from *Art. meningea media*, *pharyngea ascendens* and *carotis interna* (for *tuba Eustach.*)

Veins: they open into the *plexus pharyngeus* and *meningea media*.

Nerves: they come from the fifth, seventh, and ninth cerebral nerves; they are: *Chorda tympani*; passes from *Canalis Fallopiæ* in a canal peculiar to itself, then into the *tympanum* (between *manubr. mallei* and *proc. long. incudis*), and out through the *fissura Glaseri* to *ram. lingualis* of the *nerv. trigeminus*; it gives off no branches in the *tympanum*. *Anastomosis Jacobsonii*—gives two filaments to the membrane in the region of the *fenestra*, and one filament to the *tuba* (where by pressure of the vessels in sanguineous congestion violent pain arises).

C. The internal part, the Labyrinth.

512. 1. The osseous labyrinth, *labyrinthus osseus*.

1. The vestibule, *vestibulum*, a small oval cavity (three lines high, two broad, and one and a half deep) in the centre of the labyrinth, behind the *Cochlea*, before the *semicircular canals*, situated in the direction of the long axis of *meatus auditorius internus*, abutting externally on the *tympanum*, above, on the *Canal. Fallopiæ*, below, on the *foramen jugulare*. We see in it—

a. Seven larger openings:

1. *Fenestra ovalis* on the external wall ; it is tightly closed by the *basis stapedis*.
 2. The five openings of the three semicircular canals.
 3. *Aditus ad cochleam*, before and below the *fenestra ovalis*.
- b. Four smaller openings :
1. *Ostium aquæductus vestibuli*, on the posterior wall, internal to the common opening of the superior and inferior semicircular canals (leads to the posterior, the cerebral surface of the petrous bone).
 2. *Maculæ cribrosæ*, three of many small holes on the perforated part of the posterior wall, at the base of *meatus auditorius internus*, through which vessels and nervous twigs enter ; there is a superior, for *n. saccularis major* ; an inferior for *n. ampullaris inferior* ; and a *hemisphærica* for *nerv. saccularis minor*.
- c. Depressions, on the floor of the Vestibule, nearer to the inner wall :
1. *Recessus hemisphæricus*, anterior, smaller fossa, situated inwards towards the *cochlea*, opposite to *fenestra ovalis*.
 2. *Recessus hemiellipticus*, oval, larger fossa, rather behind and above, at the openings of the semicircular canals. Through the foramina on their base the nerves pass. The two are separated from one another by a *crista pyramidalis*.

513. 2. The semicircular canals, *canales semicirculares*,

three curved, rather elliptical cylinders, of half a line in diameter, lying behind the vestibule, two vertically and one horizontally between them. They open with the two extremities, which are rather wider than the rest of the canals, into the *vestibule*, as one extremity is expanded like a flask (*ampulla*), but with only five orifices.

a. The superior (vertical) semicircular canal, about six lines long, at the most superior part of the labyrinth, in the transverse diameter of *oss. petrosi* ; is convex above, and projects rather below the superior surface of the petrous bone. Its anterior crus expands and opens alone, on the superior wall of the vestibule ; its posterior crus in common with the superior of the inferior semicircular canal, and without expanding on the superior and internal wall of the vestibule.

b. The inferior (vertical) semicircular canal, seven lines long, narrower than the other two, describes almost a complete circle, is situated parallel with the posterior surface of the petrous bone, with its convexity directed backwards and outwards towards *proc. mastoideus*. Its superior crus opens in common with *a* ; its inferior expanded crus, one line distant from that on the inferior wall of the vestibule.

c. The external (horizontal) semicircular canal, four lines long, but wider than the other two, also lies in the long diameter of the petrous bone, with the convexity directed outwards. Its anterior expanded crus commences close above the *fenestra ovalis*, below the crus of the superior semicircular canal ; its pos-

terior crus opens between the common orifice of the two vertical canals and the inferior (ampulla) of the inferior semicircular canal.

514. 3. The *Cochlea*, a twisted canal, like a snail-shell, of four lines axial diameter, occupies the most anterior space of the internal ear, is situated internally and before the *tympanum* with its *basis* turned to the base of *meatus auditorius internus*, the apex towards *tuba Eustachii*. The canal, *canalis spiralis*, consists of two and a half spiral turns, the length of which together measures one inch, commences with its wide basis behind the *promontorium*, and contracts inwards towards the apex (*cupola*), under which it terminates in a funnel-shaped cavity (*scyphus*). The spirals pass in the right ear to the right, in the left towards the left. The cavity of the canal is divided by a thin septum, spiral plate, from the basis to the apex into a superior ladder (*scala vestibuli*), and into an inferior (*scala tympani*).

The spiral plate (*lamina spiralis*) follows the windings about the axis of the *Cochlea*, to which it is attached by its internal border, whilst the external border is attached to the circumference of the *Cochlea*. It consists of an osseous portion *zonula ossea*, which occupies the internal half attached to the axis and predominates in the first turn, and of a membranous, external half, *zona Valsalvæ*. The osseous lamina terminates in the third turn with a kind of hook, *hamulus* s. *rostrum* [where the *scalæ* communicate, *canalis scalaris communis*, Cassebohm; *Helicotrema*, Breschet], and itself consists of two plates, between which many canaliculi for the nerves of the *Cochlea* are found.

The axis, spindle, *modiolus* s. *columella*, is the porous mass of bone which fills up the space in the axis of the *Cochlea*, bounded by the concavity of the spirals. Its basis, perforated by many spirally arranged foramina (*tractus foraminulentus*, for the *nerv. Cochleæ*), rests upon the base of the *meatus auditor. internus*; above the first turn the mass is rather thickened, and is then called *columella*, and terminates as *lamina terminalis*, of a funnel shape in the half turn. The external surface of the *modiolus* is provided with two screw-like grooves which communicate through their numerous foramina with the same number of canaliculi in the interior of the *modiolus*, the largest of which in the centre, *canalis centralis modioli*, passes from the *basis* to the *lamina terminalis*.

The *Scalæ* :

a. *Scala vestibuli*, is wider than *b*, lies more anteriorly and above and opens into the *vestibule* (*aditus ad cochleam*.)

b. *Scala tympani*, lies more towards the *basis* and opens through the *fenestra rotunda* (*clausa*) into the *tympanum*. Both *scalæ*

communicate in the *lamina terminalis* through an opening in the membrane which separates them (see before).

Aquæductus cochleæ (*Cotugno*) opens into the *scala tympani* close before *fenestra rotunda*, and opens on the other side on the inferior border of the petrous bone close to *fossa jugularis*.

Both the aqueduct of the cochlea and vestibule are at last regarded as canals for small veins. Arnold, however, thinks still that they serve as vent canals. The delicate membrane with which they are lined passes over into the *dura mater* and the *periosteum* of the petrous bone.

515

3. The membranous labyrinth.

In the interior of the labyrinth, which is covered with a delicate vascular membrane (*choroidea labyrinthi*, Arnold), we find a watery fluid (*aqua Cotunnii*, *Perilymphe*), in which—but only in the vestibule and the semicircular canals—a whitish, transparent nervous membrane is suspended (*labyrinthus membranaceus*). The last forms in the vestibule two, in the semicircular canals three sacs filled with the *aquila vitrea*. *Zona Valsalvæ* (see before) separates the two *scalæ*, the *humor aqueus* of which flows through the opening at the *lamina terminalis* [*helicotrema*] from the one into the other.

a. *Canales semicirculares membranacei*, far more narrow, but otherwise similar to the osseous semicircular canals, in which they lie, they are expanded in the internal crura (*ampullæ*) and open with five orifices into the

b. *Vestibulum membranaceum*. This consists of two portions.

1. *Sacculus oblongus* (s. *utriculus ventricularis*) receives alone the five semicircular canals, is larger than 2., lies in the *recessus hemiellipticus*, separated from the *Stapes* only by the *aq. Cotunnii*.

2. *Sacculus rotundus* is much smaller, lies in the *recessus hemisphericus* under the former without communicating with it, and the *n. saccularis minor* spreads out in it.

c. *Aquila vitrea* (*Scarpæ*) s. *Endolympha*; rather a thicker fluid than the *aq. Cotunnii*, fills up the membranous tubes and sacs of the labyrinth and contains a fine crystalline deposit.

Otoconia, sand of the ear, *otolithi*, stones of the ear; these are smaller or larger accumulations of six-sided columns consisting of carbonate of lime, and an organic material (*Huschke*) which in the vestibule adhere opposite to the expansion of the nerves, and serve for the strengthening of the sounds. Larger and more distinct in the lower classes of animals (and in the embryo) their structure, in man, in spite of the researches of Breschet, Krieger, and others, is not yet determined.

Vessels and nerves of the labyrinth. *Artt. cochleæ* and *vestibuli* are branches of *art. auditoria interna*, and correspond to the

Nerves: *N. cochleæ*, the anterior stronger branch of *n. acusticus* enters through the inferior anterior fossa of *meat. auditor. internus* at the basis of the *modiolus* in its canals, and thence between the layers of the *lamina spiralis*, where the most delicate fasciculi (in loops) spread out as far as the external border. *N. vestibuli*, the posterior branch of the *acusticus*, divides at the basis of *meatus auditorius internus* into three fasciculi, the strongest of which goes to the *sacculus oblongus* and the *Ampullæ* of the vertical superior and horizontal semicircular canal; the central to the *sacculus rotundus*, and the inferior smallest to the *ampulla* of the vertical inferior semicircular canal.

516. III. The Organ of Smell, *Organon olfactus*.

The nose, *nasus*, consists of an external portion projecting upon the face and an internal covered with mucous membrane.

517. A. The external Nose, *Nasus externus*,

consists, above, of an osseous (*ossa nasi* and *process. nasales*) below, of a cartilaginous skeleton, which are immediately covered with *periosteum* and *perichondrium*, nearer the surface with muscles (see Myology), and *cutis*, on the internal surface with mucous membrane. Portions: The root of the nose, close under the forehead,—the back or dorsum of the nose,—the point or tip of the nose,—the lateral parietes, *alæ* s. *pinne nasi*,—openings of the nose, *nares*, the partition, *septum narium*.

518. 1. The Nasal cartilages, five, *Cartilagine nasi*.

- a. *Cartilago lateralis*, the lateral cartilages, are situated (one on either side) at the most superior part of the cartilaginous nose; triangular, attached above and behind by fibrous uniting tissue with *ossa nasi*. The internal borders of the two meet upon the *dorsum nasi*, where they are also firmly attached to the cartilage of the *septum*. The inferior border is convex, and meets anteriorly with *b*, behind with the fibrous membrane of the *alæ nasi*.
- b. *Cartilago narium* (s. *spinalis*), one on either side, is a more irregular semi-elliptical cartilage, the external thinner arch is situated in the groove above the *alæ nasi* and *point*, whilst the internal reaches below the *septum mobile* as far as the *spina nasalis*. A fibrous plate between the pinnal cartilages and the inferior border of the lateral nasal cartilages forms the skeleton of the *alæ nasi*, in which (generally) small flat cartilaginous nuclei (*cart. sesamoideæ*) exist.
- c. *Cartilago septi narium*, the septal cartilage, thick, flat, and triangular, meets with its superior posterior border, the *lamina perpendicularis* of the *Ethmoid* bone; its inferior border is placed between the two plates of the *Vomer*; its anterior border unites upon the back of the nose with the *cartt. laterales*, and below with the *cartt. narium*. Behind a pro-

cess projects from it into the angle between *lamina perpendicularis oss-ethmoid.* and *Vomer*. It separates the two halves of the nasal cavity.

2. The muscles of the nose: *levator labii alæq. nasi*, *compressor* and *dilatatores narium*, *depressor alæ nasi*, *pyramidalis* and *depressor septi mobilis* (see Myology).

3. The skin of the nose is very thick and strong on the *alæ nasi* and below the *septum*, and passes at the *nares* into the mucous membrane, the commencement of which is beset with stiff hairs (*vibrissæ*). It is also furnished with many *folliculi sebacei*, which frequently appear as black punctules.

4. Vessels and nerves. Arteries: branches of *maxillaris externa*, *infra-orbitalis*, and *ophthalmica*. Veins form *plexus nasalis*. Nerves: branches of *plex. infraorbitalis* and of *N. ethmoidalis*.

519. B. The Cavity of the Nose, *Nasus internus*.

The cavities of the nose, *fossæ nasales*, are covered with the nasal mucous membrane, *membrana pituitaria* s. *Schneideriana*, the proper seat of the sense of smell. This membrane is thick, soft, rosy red, very vascular and largely supplied with nerves (in the neighbouring cavities, *sinus frontales*, *ethmoidal.*, *sphenoidal.*, and *antrum Highmori*, we find instead of it a delicate, fine periosteum covered with ciliated epithelium.) Numerous mucous follicles cover the free surface, whilst the external is firmly attached to the periosteum and perichondrium. It continues upon the palate and pharynx, the lacrymal canal, and Eustachian tube, the openings of which, as well as those of the *sinus*, it generally covers like a veil. [There is ciliated epithelium on the mucous membrane lining the nose.]

We observe in it the *meatus narium*:

1. The superior nasal chamber, below the superior turbinate bones, with the openings of the posterior ethmoidal and the sphenoidal cells.
2. The central nasal chamber, below the middle turbinate bones, with the openings of the anterior ethmoidal cells, the *sinus frontalis*, and *antra Highmori*.
3. The inferior nasal chamber, below the inferior turbinate bones, with the openings of the *canal. lacrymal*.

Vessels and Nerves: *Art. sphenopalatina* and *ethmoidalis*. Veins: form very large *plexuses*, and pass into *plex. pterygoid.* and *ven. maxillar. interna*. Lymphatics: form a very close superficial rete.

Nerves: *Nn. olfactorii*, *ethmoidales*, *naso-palatini* *Scarpæ*, and *nasales*. (Branches of *Nerv. trigeminus*).

ANGIOLOGIA.

VASCULAR SYSTEM.

“In the history of Physiology, I have shown that those who studied the structure of animals were irresistibly led to the conviction that the parts of this structure have each its end or purpose; that each member and organ not merely produces a certain effect or answers a certain use, but is so framed as to impress us with the persuasion that it was constructed *for* that use; that it was *intended* to produce the effect. It was there seen that this persuasion was repeatedly expressed in the most emphatic manner by Galen; that it directed the researches and led to the discoveries of Harvey; that it has always been dwelt upon as a favourite contemplation, and followed as a certain guide by the best anatomists; and that it is inculcated by the physiologists of the profoundest views and most extensive knowledge of our own time. All these persons have deemed it a most certain and important principle of physiology, that in every organized structure, plant, or animal, each intelligible part has its allotted office; each organ is designed for its appropriate function; that nature, in these cases, produces nothing in vain; that, in short, each portion of the whole arrangement has its *final cause*; an end to which it is adapted, and in this end the reason that it is where and what it is.”—WHEWELL. *Indications of the Creator*, p. 75.

ANGIOLOGIA.

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520. THE VASCULAR SYSTEM.

The nutritious fluid moves in closed flexible tubes, which traverse the body in all directions. That division of these tubes, through which the blood moves, has a contractile organ as the central point, from which blood is impelled into the tubes, and to which it returns from the tubes.

The other division, in which the Chyle and Lymph move, does not possess in itself such a central point, but in the blood system, to which it carries its contents, without being immediately distributed from its orifice.

521. *The System of Vessels carrying Blood.*

Central organ—the heart. From it vessels go off—the arteries (pulsating vessels). To it vessels lead back—the veins (blood vessels). Very delicate ramifications and transitions between the two kinds of vessels. Capillary vessels.

522. Course. The vessels, *vasa*, are cylindrical tubes, the largest trunks of which lie in the neighbourhood of the central organs, and the branches of which, going off at an acute angle, diminish in circumference towards the periphery. The effect of this continued division however is, that the calibre of the branches taken together is wider than that of the trunk from which they came off.

Many branches divide from one trunk, and pass to another, without diminishing in circumference, that is, they anastomose. Their course is curved or in the form of an acute angle. If they are numerous, and the interspace between them only small in proportion to the organ, they are called Plexuses, which is particularly remarkable in the venous trunks. When larger branches suddenly divide into a number of smaller vessels united together, without previous arborescent separation, the so-called *rete mirabile* is formed, for example, in the lungs. The capillary vessels also form a network, but which by gradual, always more delicate, division, arises from large vessels. The more narrow and complicated the course through which the blood has to circulate, so much the longer it is delayed therein.

Structure of the vessels. The parietes of the vessels consist of six membranous layers, which are not, however, always present at the same time in every vessel.

a. The innermost layer, which lies next to the cavity of the vessel, is a thin,

granular membrane of pavement epithelium, which is also seen in the most delicate capillaries.

b. The striated or fenestrated membrane is delicate, clear, fragile, and rolls up at the corners.

c. The longitudinal, fibrous membrane is distinctly seen in large vessels. It is, like a. and b., formed of oval cell nuclei or fibres, which are placed longitudinally, in which direction the membrane may be torn off; and it was formerly considered, with a. and b. as the most internal layer of the vessels.

d. The circular, fibrous coat (so-called *tunica med.*) is thick, contracting upon certain stimuli (falsely, *tun. elastica*); consists of short parallel fibres, which are soluble in acetic acid, and of dark striæ, which are only rendered transparent by the acid; it is fragile, and tears off transversely.

e. The elastic coat is only present in the larger arteries and veins; is white, thinner than d.; is neither soluble in, nor rendered transparent by acetic acid; tears off neither in the longitudinal nor transverse direction, and consists of very branched, often reteform, fibres.

f. The external tunic (*tun. adventitia*) forms with e. the hitherto so-called *tunica externa*; it consists of fibro-cellular tissue, with oval nuclei in a longitudinal direction, and passes from the larger vessels into the surrounding amorphous, fibro-cellular, or uniting tissue.

The nutrition of the larger vessels (above half a line diam.) is supplied by small arterial twigs (*vasa vasorum*), which do not come immediately from the cavity of the vessel for which they are destined, whilst the venous ramusculi open into those veins, from the coats of which the blood collects. The *vasa vasorum* themselves, as well as the capillary vessels, are nourished by the blood circulating in them.

Nerves: (*nervi vasorum*) the vessels obtain their supply from the *N. Sympathicus*.

523.

I. Capillary vessels, *vasa capillaria*,

are the blood-vessels intermediate between the arteries and veins, the branches of which form a net-work with each other, and tolerably equally-sized meshes. In these meshes is placed the peculiar substance of the tissue, and it receives its nutrition from the blood of the vessels (metamorphosis of matter). The blood circulating in them is neither arterial nor venous; in the finest vessels it appears colourless; it generally flows in a direction from the arteries, which here terminate, to the veins, which commence at this point. It is impossible to draw a definite limit between the terminations of the arteries and the commencement of the veins. Structure. In the parietes of the capillary vessels (which are not merely canals in the parenchyma of organs), pavement epithelium, and, most externally, a tunic of areolar tissue, has been found.

The forms of their network vary according to the diameters of the vessels (the finest in the brain = 0.008 of a line; the largest in the medulla of the bones = 0.010 of a line); according to the breadth of the meshes, which is so

much the more minute, the larger the consumption of blood (the narrowest network is in the lungs, the glands of the skin, the mucous membranes, &c.) According to the shape of the space bounded by them, we may distinguish roundish or oval (*e. g.* in the lungs, the corium, the glands), and longitudinal or elongated meshes (in the nerves and muscles). Ball-shaped, convoluted meshes are only found in the cortical substance of the kidneys (*e. g.* *glomeruli Malpighi*).

Function. The capillary vessels impart, through their thin (not porous) walls, the nutritious material of their blood to the organs, in which they spread out and ramify, and on the other side they take up, likewise (in the lungs), the inspired oxygen. *Vasa exhalantia*, exhaling vessels.

524. II. Pulsating vessels, *arteriæ*,

are the vessels, the trunks of which arise from the ventricles of the heart, and which distribute the blood throughout the body. Their walls are thicker, and more elastic than the rest of the vessels. The smaller arteries possess, relatively, the strongest parietes; the thinnest arteries are those of the cranial cavity. They pulsate, that is, they extend in length and breadth, when the ventricles of the heart contract (*systole*), and thereby force their blood into the arteries, and they again become narrower and shorter, when the ventricles of the heart dilate (*diastole*). The arteries are further distinguished by their great elasticity and contractility. The first produces retraction when the arteries are divided across; the last a narrowing, but not collapse, as happens in the veins. Of the coats, before all, we remark:

That consisting of *circular* fibres (the so-called middle, elastic coat). It is thick, yellowish white, dry, and fragile, and the medium of contraction. It is distinguished from the muscular tissue by its easy solubility in nitric, insolubility in acetic acid, and by yielding gelatine on boiling; from the fibro-cellular or uniting tissue, by insolubility in boiling acetic acid, difficult solution in mineral acids, caustic potash, and gastric juice.

The external, properly elastic coat of arteries, is firm, and stronger than in the veins, and is remarkable for not dividing when an artery is included in a ligature, which the internal coat does.

The inner coat, *tun. vasorum comm.*, that is, the striated tunic (for the tunic of longitudinal fibres is usually wanting), is only in a diseased condition as thick as we are accustomed to find it, especially in old people, when it is so much the more fragile.

The arteries take a serpentine course, generally deeper than the veins and lymphatics, the larger on the flexion side of the joints, and convey (the pulmonary excepted) bright red blood.

525. III. Blood-vessels, *venæ*, veins,

originate from the capillaries, and open into the auricles of the heart. Their walls are thinner, and more lax, and when the vessel is empty, they fall together, as the elastic coat is entirely wanting in them; the contractile, circular,

fibrous coat, much thinner, or only consisting of bundles of fibro-cellular tissue, in place of which, on the superior and inferior *cavæ*, and on the pulmonary veins, muscular tissue is found. The tunic of longitudinal fibres (here *tunica interna*) is always present in the larger veins; it does not easily lacerate. The striated tunic and epithelium line them inside, in thinner or thicker layers.

Peculiar to the veins are their valves, *valvulæ*, which are semilunar flaps of fibrous tissue, the free concave border of which is directed towards the heart, and which closes up the calibre of the vessel against the retrograde course of the blood. In small vessels (of one line diam.), single, in larger, two or three placed opposite each other, the valves are wanting in the abdominal, and chiefly in those veins which are protected against the pressure of the column of blood or the pressure of muscles on hard parts; they are, on the contrary, especially numerous in the inferior extremities. In the larger valves we find two layers, and fat. Moreover they are not duplicatures of the internal coat (see Lymphatics).

The veins generally take a straight course, are wider, and form more frequent anastomoses than the arteries, and carry (the pulmonary veins excepted) dark red blood, rich in carbon.

526. IV. Lymphatics, *vasa lymphatica s. resorbentia*,

form a system of vessels which must be considered as an appendage to the venous system. The tubes are narrow, thin-walled, flat, and provided with numerous valves. The commencements of the lymphatics probably form a rete, the tubes of which, like those of the capillaries, are of pretty equal size, and which are to be sought upon the surface and in the parenchyma of all organs. From the rete the minute tubules coalesce, generally pass in a straight course with the blood-vessels, form Plexuses, here and there convoluted, complicated ganglia, *lymphatic glands*, and lastly, one large trunk (or several), which opens into a great vein.

Those lymphatics are called *chyle vessels*, which arise inside the intestinal villi beneath the mucous membrane (of the small intestines), not with rete-form, but with fine, club-shaped, closed tubes.

Structure. The walls of the lymphatics are transparent, more delicate, but more extensible, and stronger than those of the blood-vessels. In the larger trunks we also distinguish in them: a. an innermost layer of pavement epithelium; b. a coat of longitudinal fibres; c. a coat of circular fibres, with fasciculi of areolar tissue, which blends with the surrounding uniting and adipose tissues.

The numerous valves, generally arranged in pairs, consist of fibro-cellular tissue, with fibrous unyielding rings attached to the walls of the lymphatics, which produce contractions in the distended vessels, and therefore a knotted appearance.

The function of the lymphatics consists in the reception of the Plasma (Lymph) passing out of the blood-vessels, and of the nutritious fluid (Chyle) formed in the intestinal canal.

They are, therefore, wanting in non-vascular parts, *e. g.* in the teeth, the crystalline lens, &c. They are probably not wanting in the substance of the brain, spinal cord, eye, internal ear, placenta, the membranes of the egg, and the umbilical cord, although they have not been yet found in them.

Lymphatic glands, *glandulæ lymphaticæ s. conglobatæ*, are oval, generally flattened and reddish bodies, with a smooth, even surface, and one line to an inch in diam., lying generally dispersed in groups, especially in the popliteal and inguinal regions, the axillary fossa in the neck, at the roots of the lungs (black), in the mesentery, and in the liver (yellow), but never in the substance of organs. The larger are invested by a fibrous tunic, and contain (besides the numerous convolutions and ramifications of the lymphatics, besides the amorphous areolar tissue, blood-vessels and nerves) small cellular spaces, with granules (acini), and thus form, perhaps, actual glands, like the spleen, in which the lymph obtains a particular substance, which it prepares for the change into blood. Almost every lymphatic vessel passes into one of these glands and out again (*vasa in- and efferentia*).

A delicate capillary rete, investing the lymphatic glands and vessels very abundantly, serves to nourish them. Nerve filaments have been at least found in the lymphatic glands.

527.

The heart, Cor, καρδιά,

A hollow conical muscle, lies, surrounded by a serous envelope (pericardium), in the centre of the thorax, between the lungs, above the diaphragm, behind the sternum and before the vertebral column, in rather an oblique direction from above downwards, from right to left, and from behind forwards.

It is composed of two halves, a right venous and a left arterial, each of which is again separated by a septum into two communicating portions. The heart contains four cavities, viz.:

the auricle (*atrium*) and the ventricle (*ventriculus*) of the right, and

the auricle and ventricle of the left side of the heart.

The cavities are lined by *tunica vasorum communis* [endocardium], the outer surfaces receive a continuation from one of the layers of the pericardium.

We have to observe of the Heart: a. the *basis*, that is, the superior and posterior part, at which point the vessels enter and from which they pass out, which lies behind the right border of the Sternum, before the eighth to the sixth dorsal vertebra, and is bounded by *sulc. circularis*. b. The apex, *apex s. mucro*, obtuse and slightly curved backwards towards the space between the sixth and seventh left ribs, presents a depression, *vallecula*, with two elevations. c. The superior, convex surface looks towards the sternum, the inferior flat rests upon the diaphragm. d. The

rounded lateral edges point out the direction of the heart from right to left. e. *Sulcus longitudinalis*, that is, a shallow groove which passes downwards from the basis as far as the apex in a curved course and indicates the septum between the right and left half of the heart. f. *Sulcus circularis*, a deep transverse groove which marks out the boundary between the auricles and ventricles.

Measurements. Length = $4\frac{3}{4}$ inches,
 Breadth = $3\frac{1}{2}$ inches,
 Thickness = $2\frac{1}{2}$ inches,
 Capacity = 32 cub. inches.

Weight. In male = 9 ounces,
 In female = 8 ounces, 5 drachms.

After the thirtieth year it always rather increases.

1. The auricles, *atria*, are to be regarded as dilatations of the large veins, the blood from which they receive, and pour it (through *ostia venosa*) into the ventricles. They are situated at the most external portion of the *basis cordis*, are nearly quadrangular, two inches high and broad, provided with thin walls, and a blind, pocket-like appendage, auricle, *auricula cordis*, and separated from one another by a partition (*septum atriorum*).

The anterior surface is concave, without a longitudinal groove, covered by *Aorta* and *Art. pulmonalis*.

The posterior surface is convex, presents a longitudinal groove (near it, to the right, the opening of the *ven. cava infer.*, underneath, that of the *ven. magn. cordis* [coronary vein], and is separated by the aorta and oesophagus only from the vertebral column.

The superior extremity looks backwards and to the right, lies under the *bifurcatio tracheæ*, presents a longitudinal groove, to the right side of which lies the opening of *Ven. cava superior*, to the left are seen the four openings of the *four pulmonary veins*.

2. The ventricles, *ventriculi cordis*, give origin to their arteries, and force the blood which they have received from the auricles into them. They are situated below the *sulcus transversus*, form the middle and the apex of the heart, and are provided with thick external walls, and a partition (*septum cordis*), which separates the one from the other. Their anterior surface, particularly the part which lies to the right of the longitudinal groove, looks towards the sternum, and lies, in large hearts, immediately behind it.

528.

The Cavities.

1. *Atrium dextrum*, right auricle, caval dilatation, lies behind the third to the sixth costal cartilage and the body of the sternum, rather covered by the anterior border of the right lung. From its superior angle the right appendix passes inwards and upwards, covering the commencement of the aorta. Its

cavity is formed by three walls, an anterior convex, an internal (the septum), and a larger posterior, concave. It presents in the adult three, in the fœtus four openings.

a. The crescentic opening of the superior cava, separated by a fasciculus of muscle from the appendix on the left, from the inferior cava on the right, without valves, looks downwards and rather backwards.

b. The crescentic opening of the inferior cava, larger than the former, close to the septum, not vertical from below upwards, but directed obliquely (at a right angle to the vein), with the half-moon-shaped *valvula Eustachii* on the anterior border, which completely closes the opening in the embryo only. The free concave border of the Eustachian valve looks upwards, the attached convex downwards.

c. The opening of *vena magna cordis* [coronary vein] lies before the last described, separated from it by the Eustachian valve; is closed by a thin, crescentic valve, *valvula Thebesii*, the superior extremity of which continues into the inferior of the *valv. Eustach.*

Several small *foramina Thebesii* are found below the opening of the superior cava, but they are not to be considered as the openings of smaller cardiac veins.

d. *Foramen ovale*, in the embryo, is a longitudinal opening in the posterior inferior part of the septum between the auricles. At birth is already found in its place a smooth or wrinkled, but thin layer, *fossa ovalis*, bordered above and before by a crescentic, fleshy protuberance, *isthmus Vieussens*, the inferior extremity of which passes into the *Valv. Eustachii*. A depression with a small foramen is frequently found in the oval fossa behind the *isthmus*, as the remains of the oval foramen.

Valvula foramin. ovalis (of the fœtus) is the membranous portion spread out in the circle of Vieussens, the continuation of the inner coat of the left circumference of *ven. cava super.*, whilst the *valvula Eustachii* proceeds from the right circumference.

Tuberculum Loweri, the elevation at the upper part of *septum atriorum*, between the mouth of *v. cava sup.* and *fossa ovalis*, which directs the stream of blood from *v. cava sup.* upon the posterior inferior circumference of the right auricle, and that of *v. cava infer.* forwards, and to the right towards the right appendix.

2. Right ventricle, *ventriculus dexter.*, pulmonary ventricle, at the anterior inferior part of the heart, directed obliquely to the left and downwards from its auricle, does not reach the extreme apex. Its internal wall (*septum ventricular.*) is convex, and on its lower half like trellis-work. The anterior and inferior walls are concave, thin and loose, and beset with an interlacement of fleshy fasciculi (*mm. papillares*), as they are found, also, particularly developed in the cavities of the auricles. At its base the two following openings are found:

a. Right auricular-ventricular opening, *ostium venosum*, at the posterior, right part of the base of the ventricle, is elliptical (from before to behind), six-

teen to eighteen lines long, twelve lines broad, and connects the auricle with the ventricle. From a fibro-cartilaginous ring, which encircles it, the inner membrane (*endocardium*) forms a three-curtained, annular valve, *valvula tricuspidalis*, *τριγλοχινεις*, which projects with its smooth surface into the auricle, with an uneven surface, produced by small tendinous cords, into the ventricle. The cords are partly attached to the free border, partly to the surface of the valve, and they are so arranged that the latter becomes stretched when their muscular fasciculi contract.

b. Arterial opening, *ostium arteriosum*, is situated at the anterior, left part of the base of the ventricle, is separated from the auricular opening by a projecting edge of muscle; it is circular, and surrounded by three semilunar valves, *valva semilunares*, *sigmoideæ*, which above form open pouches, and close the ventricle against the pulmonary artery, as they lie close to one another, and *nodulus Arantii* (a thickening in the centre of the free C-shaped margin of each pouch), also shutting the triangular space yet remaining open.

3. Left auricle, dilatation of the pulmonary veins, *atrium sinistrum*, is placed higher than the right, concealed behind *Art. pulmonalis*, *Aorta*, and *left lung*. The left appendix, longer and smaller than the right, is placed on the anterior surface, close to *Art. pulmonalis*, and its conical cavity opens with a circular mouth into the auricle. The cavity of the left auricle is narrower than the right, and presents, (besides the *foramen ovale* and the *ostium venosum*) at its upper part the four mouths of the pulmonary veins, two on either side.

4. Left ventricle, Aortic ventricle, *ventriculus sinister*, is situated further behind than the right, towards the left and above, is conical (the right being pyramidal), convex, its cavity oval; the apex reaches farther down; the walls are three to four times thicker; two openings.

a. *Ostium venosum*, between auricle and ventricle; elliptical, large (quite close to the following opening, external to it, so that the valves of the two meet together), is closed by a two-curtained valve, *διγλοχινεις*, *valvula Mitralis*. The tendinous cords (*chordæ tendineæ*) are attached to the borders of the valve, and are stronger than in the right ventricle.

b. *Ostium aorticum* is of the same character as the arterial opening in the right ventricle, closed by *valv. semilunares* [more developed].

Situation. The heart lies for the most part in the left half of the chest, one inch to an inch and a half to the right, and three to three inches and a half to the left of the central line (in the Embryo up to the third month vertical); its highest point (the left auricle) corresponds to the fifth dorsal vertebra; its deepest part (the inferior border of the right heart) to the ninth to tenth dorsal vertebra; the apex to the space between the fifth and sixth rib cartilage; the mouth of the pulmonary artery to the third, that of the Aorta to the space between the third and fourth left rib cartilage, close to the border of the Sternum. Behind the Sternum and the pericardium we meet in the following order from before backwards with: 1. the right ventricle; 2. the pulmonary artery; 3. the right auricle; 4. the left ventricle; 5. the aorta;

6. the left appendix; 7. the right auricle; 8. the superior cava; 9. the left auricle; 10. the pulmonary veins (Blandin).

Structure. The chief mass of the heart consists of round and flat muscular bands (transversely striated fibres), which are throughout separated into two halves, lying evenly close to one another on the outer surface, projecting irregularly on the inside of the cavity, as they are either firmly attached at both extremities (fleshy bands, *trabeculæ carneæ* [*musculi pectinati*]), or the free pointed extremity is turned to the basis of the heart (*mm. papillares* [*carneæ columnæ*]). In the ventricles the muscular layer is as thick as eight lines; at places in the ventricles extremely thin. Fibro-cartilaginous filaments separate the auricles as well as the ventricles (in the septa) from one another, and the auricles from the ventricles (in the circular groove). The outer covering is formed from the internal layer of the pericardium, and attached by fibro-cellular, containing adipose tissue. Fat is found, particularly in aged (also in lean) individuals on both sides of the transverse groove, and along the coronary vessels as far as the apex, especially on the right half of the heart. The internal membrane, *endocardium*, the immediate continuation of the internal coat of the large venous trunks, lines the cavities of the auricles and ventricles, forms folds at the passage into the latter and in the great arterial trunks, between which two layers, areolar tissue, and fibro-cartilaginous filaments, are found.

These folds projecting into the cavities are the

Valves, which are free in the mouths of the arteries (as *valv. semilunares*), in the mouths of the ventricles (as *valv. bi-* and *tricuspidates*), are connected by tendinous filaments with the *musc. pectin.* and *column. carneæ*.

The internal membrane of the heart is thickest in the auricles.

Thickness of the walls:

Left ventricle,	in male, $5\frac{1}{11}$	Par. lin.;	female, $4\frac{1}{2}$
Septum of ventricles	— 5	—	— $4\frac{1}{2}$
Of right ventricle	— 2	—	— $1\frac{1}{2}$

The cavities and openings of the right half of the heart are wider than those of the left.

529. Vessels and nerves of the Heart.

Arteries: *coronaria cordis dextra* and *sinistra* from *aorta ascendens*.

Veins: *coronaria cordis magna* and *media*.

Lymphatics: accompany the arteries and pass into the lymphatic glands above and behind the *arcus aortæ*.

Nerves: *plexus coronarii* accompany the arteries and are then lost in the tissue of the heart, arising from *plex. cardiacus magnus*, and these from *Nn. cardiaci* of *N. Vagus* and *sympathicus*.

530. The Pericardium,

is a fibro-serous, perfectly closed sac, in which the heart has been so inverted that it is wrapped round as far as its base, and is covered with a serous mem-

brane firmly attached to it. The heart lies also on the surface, not in the cavity of the sac, and is loosely surrounded by the non-inverted portion of the pericardium, so that it can move freely therein. The inverted, *internal* layer of the pericardium passes over the base of the heart, since it leaves uncovered a narrow stripe only of the left auricle, on the great vessels (*ven. cava super., aorta* and *Art. pulmonal.*) into the free, *external* layer, and surrounds the vessels like a sheath. To the *external* surface of the *free* layer we find a thin fibrous lamina firmly attached, which at the anterior inferior part is united with the tendon of the diaphragm (three and a half inches transversely, one to two inches from before to behind, close to the Sternum) and also passes over upon the vascular trunks. The cavity of the pericardium secretes a humid vapour, which in disease, or after death, becomes fluid, as *lig. Pericardii*; its walls are smooth.

The shape of the pericardium is a cone, the base of which lies upon the *speculum Helmontii*, of the diaphragm, the apex looking upwards (to the great vessels). Its anterior surface is covered by pleura, and touches the sternum with only a small rhomboidal piece covered by areolar tissue (corresponding to the right half of the heart). The posterior surface is separated from the vertebral column by the *mediastin. post.* with *œsophagus, Aorta, duct. thoracic., &c.* At the sides the *Nn. phrenici* and *Artt. phrenic. sup.* pass between *pericardium* and *pleura*.

Vessels: *Artt. pericardiæ*, or branches of *aorta descend., mammar. intern., phrenicæ super., bronchiales, thymicæ* and *œsophageæ*.

Veins: pass with the arteries, and open partly into *Ven. azygos*.

Lymphatics: go to the glands on the *V. cava superior*, and into the *ductus thoracicus*.

Nerves: have not hitherto been found.

531. Circulation, course of the blood, *Circulatio sanguinis*,

differs according as to whether the lungs (after birth) effect the change of the dark red blood into the bright red, or the placenta (before birth) is the medium for the exchange of the consumed, for a blood containing nutritious substances.

532. I. *Circulation after birth.*

It is divided into two sections:

1. Smaller circulation, course of the pulmonary blood.—The venous blood collects from the *vv. cavæ* and *coronariæ cordis* in the right auricle of the heart, passes into the right ventricle, thence into the pulmonary artery and lungs. From the capillary rete of the lungs it comes forth as arterial blood, and returns through the pulmonary veins to the heart, but to the *left* auricle.

2. Greater circulation, course of the blood through the body.—Pressed by the left auricle into the left ventricle, thence into the aorta, the bright red blood streams through all arteries (with the exception of the pulmonary),

becomes changed into the dark red blood in the capillary rete of the body (in opposition to the lungs), passes through the veins (with the exception of the pulmonary) and returns through the *vv. cavæ* and *coronariæ cordis* (see before) to the right auricle.

533. II. *Circulation of the mature fœtus.*

1. From the right auricle the blood passes out, a. of *v. cava inf.* through the *foram. ovale* (partly) into the left auricle (partly into the right ventricle), hence into the left ventricle, *aorta ascendens*, *truncus anonymus*, *carotis* and *subclavia*; b. the blood of *v. cava superior* into the right ventricle, *art. pulmonalis* and through the *ductus arteriosus Botalli* into the *aorta descend.* (in great part) into *two artt. umbilicales* and in these through the umbilical cord into the placenta.

2. From the Placenta the blood passes back through the *vena umbilicalis* into the belly of the fœtus; goes along through a branch of *v. umbilicalis* to the *ven. porta*, through another, *ductus venosus Arantii*, to the *v. cava infer.* into which also the blood of the liver and of the inferior half of the body empties itself.

534. A. *The vessels of the small circulation,*

namely, *Art. pulmonalis*, which carries the blood from the right half of the heart (venous blood) into the lungs; and

Venæ pulmonales, which carry back into the left half of the heart the blood which having passed through the *Art. pulmonalis* to the lungs has been changed into arterial blood by the influence of the inspired air.

535. 1. The pulmonary artery, *arteria pulmonalis s. venosa*, arises above and before from the right ventricle (thirty-one and a half to twenty-nine and one third lines wide), is situated at the commencement before, then to the left of the *aorta*, since it inclines to the posterior and right concave side of this, between the auricles of the heart, afterwards before the left auricle, it finally divides after a course of one and a half to two inches into two branches which embrace the arch of the *aorta*, enter into the lungs, and after fine ramifications, anastomosing with the *Artt. bronchiales*, they form a capillary rete round about the vesicles of the lungs, from which the pulmonary veins arise.

a. The right branch, sixteen to eighteen lines long, and larger than the left, passes away towards the right and behind *aorta ascendens* and *V. cava superior*, before the *bronchus dexter*, above the superior right pulmonary vein, and enters with three branches into the three lobes of the right lung.

b. The left branch, one inch long and narrower, passes away to the left and backwards, before the *aorta descendens* and *bronchus sinister* (separated from the last, sometimes by *art. bronch.*); above the left superior pulmonary vein and enters with two branches into the two lobes of the left lung, where the pulmonary veins are situated before it.

In the embryo, a canal, *ductus arteriosus Botalli* passes upwards obliquely to the left from the place where the pulmonary artery divides into its two branches, to the concavity of *arcus aortæ*, opposite to the *art. subclavia sinistra*, which at a later period changes into the *ligam. arteriosum* (one to two lines thick, four long).

536. II. Pulmonary veins, four, *Venæ pulmonales s. arteriosæ*, arise from the capillary vessels of *Art. pulmonalis* and *Artt. bronchiales*, pass out at the roots of the lungs before the arterial and bronchial branches, two, as well as from the right (at the commencement three), as from the left lung, and sink inside the pericardium behind *V. cava super.* on the right side and *Art. pulmonalis* on the left, into the superior part of the left auricle. They possess no valves. The capacity of all four together, is inferior to that of the pulmonary arteries.

Vessels of the large circulation, Arteries.

537. *Arteria Aorta*, the great artery of the body, arises above and before from the left ventricle (between *septum ventricul.* and *valv. mitralis*), where its root (*bulbus aortæ*) corresponds to the three semilunar valves, presents internally three pouch-shaped expansions (*sinus Valsalvæ*), and externally three elevations (*tubera*). At the origin circular (in the male thirty-one, in the female twenty-eight Paris lines wide), farther on elliptical, anteriorly convex.

538. Course. It ascends from left to right (*aorta ascendens*), at the same time a little curved, between *Art. pulmon.* and *V. cava superior*. It now bends suddenly backwards, and passes almost horizontally (above the *ramus dext. art. pulmonal.*) from right to left, and from before backwards, to the left side of the third dorsal vertebra (*arcus aortæ*); whence it descends, after another curvature, vertically on the left side of the vertebral column, through the thorax (*aorta descendens thoracica*), and in the abdomen before the centre of the bodies of the vertebræ, as far as the fourth lumbar vertebra (as *aorta desc. abdominalis*). Here it divides into its two terminating branches, *arteriæ iliacæ*.

539. *Aorta ascendens*, the ascending Aorta, two to two and a half inches long. Position: surrounded by the pericardium; below, behind *Art. pulmonalis*, which winds like a screw from before to the left; behind: *ramus dexter art. pulmonalis*; to the right above: *V. cava superior*; to the right below: the right auricle.

Branches :

1. Small twigs for *Art. pulmonalis* and *V. cava superior*.
2. *Art. coronaria cordis dextra cardiaca*, the coronary artery, arises from the anterior surface, close above the *tuber antierius bulbus aortæ*; is thicker, passes away behind *Art. pulmonal.*, in the *sulcus transversus*, on the right half of the heart towards the right and behind, and then in the longitudinal groove as far as the apex of the heart. Branches: for the right half of the heart, *bulbus aortæ* and *Art. pulmon.*
3. *Art. coronaria cordis sinistra*, arises above *tuber posterius*; passes off into two branches.
 - a. *ramus anterior s. descendens* on the anterior surface of the heart in the longitudinal sulcus, reaching downwards as far as the apex, and sending branches to the right and left ventricles.
 - b. *Ramus posterior s. circumflexus* passes on the left to the posterior surface of the heart in the *sulcus transversus*, and sends branches to the left half of the heart.

540. *Arcus Aortæ*, the arch of the Aorta.

Situation: oblique from before, backwards, and from right to left (one and a half to one inch long).

1. On the anterior and left side: the left Pleura, *Nn. Phrenicus* and *vagus*.

2. Behind and to the right: the *trachea*, the commencement of *bronchus sinister*, the *œsophagus*, *ductus thoracicus N. recurrens*, vertebral column and lymphatic glands.

3. The highest point of the convexity directed upwards is situated about ten to twelve lines below *manubrium sterni*.

4. The concavity is placed above: *ram. dext. Art. pulmonalis*, *N. recurrens sinister*, *bronchus sinister*, lymphatic glands.

Branches: from the concavity only very small branches to the *bronchi* (*bronch. superr.*), *pericardium*, *thymus*; from the convexity: *Art. anonyma [brachio-cephalica]*, *art. carotis* and *subclavia sinistra*.

1. *Anonyma s. truncus anonymus* [*s. brachio-ceph.*], the common trunk of *Art. carotis* and *subclavia dextra*, is thick and one inch (to two) long; arises the farthest upwards, to the right and before from the aortic arch; is situated behind the *manubrium sterni* and *vv. jugulares communes*, a little before, then to the right of the *trachea*; it describes with the *Carotis sinistra* an acute angle. Sometimes also the *Carotis* and *subclavia sinistra*, or even both *carotides* and *subclaviæ* arise from a common trunk.

2. *Carotis communis sinistra*, arises from the centre of *arcus aortæ* to the

left and behind the *anonyma*, is longer than the *Carotis communis dextra*, and passes obliquely before the *trachea* and to the left of it and the thyroid gland.

3. *Subclavia sinistra*, arises the farthest backwards and to the left, from the *arcus aortæ*, is longer, rather thicker, and ascends in a rather straighter direction than the *subclavia dextra*, to the left and externally.

541. A. *Carotis communis*, the common carotid artery.

Origin: the right arises from the *A. anonyma*, the left close to *A. subclav. dextra*; on the right close to the *trachea*. The left from the centre of *arcus aortæ* itself. Course: both carotids ascend obliquely upwards and outwards, from the chest into the neck, and terminate at the superior border of the *larynx* with an enlargement, so that they diverge from below (where *trachea* and *œsophagus*) upwards (where *larynx* and *pharynx* lie between them).

Situation: 1. In the chest.

a. The right *Carotis* commences only very shortly before the superior border of the *Manubrium sterni*, from which it is separated by *ven. jugular. comm. sinistra*.

b. The left, about one inch before its exit, lies behind *V. subclavia sinistr.*, *mm. sterno-hyoidei* and *thyroidei* and *sternum*; before *trachea* and *œsophagus*, *Artt. subclavia* and *vertebr. sinist.*

2. In the neck: in a sheath of *fasc. cervicalis*; the inferior half of the anterior surface covered by *mm. sterno-thyroideus*, *sternomastoideus*; the centre by the tendons and the superior belly of *m. omo-hyoideus*; the superior half in the *trigonum cervicale superius* only by *platysma-myoides*. The posterior surface is separated from the vertebral column by *mm. rectus capitis* and *long. colli*, and (below) *Ven. thyroidea inferior*. Internally are situated: *trachea*, *œsophagus*, *larynx*, and *thyroid gland*. Externally: *V. jugularis interna*. Between these and the *Carotis: ram. descend.* *N. hypoglossi* (the farthest forwards), *N. vagus* (inwards), *N. Sympathicus* (externally and behind). The first passes downwards only to the centre, the two last vertically along the entire cervical portion of the carotis.

Branches pass off from the *Carotis communis* as exceptions only, as: *Art. thyroid inf. (and media)*; but it divides into two terminal branches, into *Carotis externa* and *interna*.

542. I. *Carotis externa s. facialis*.

Origin: on an elevation with the superior border of the *larynx*, internal to and before *Carotis interna*. Termination: at the neck of *Condylus mandibulæ*. Course: in adult slightly undulating;

in the *trigonum cervicale superius* vertically as high as the *m. digastricus*: then backwards and outwards as far as the angle of the inferior jaw; then again vertically along the posterior border of *ramus mandibulæ*. Circumference: inferior to that of the *carotis interna* (in children); length, two and a half to three and a half inches. Situation: at the commencement covered by *V. facialis commun.*, and *platysmam.*, only; then behind *mm. digastricus* (the posterior belly), and *stylo-hyoideus* (before *m. styloglossus*), and *n. hypoglossus*; lastly, within the *Parotis* (and quite above between *Parotis* and lower jaw).

Collateral branches; three anterior: *A. thyroidea super.*, *lingualis maxillar. extern. s. facialis*.

2 Posterior: *Aa. occipitalis* and *auricularis*.

1 Internal: *A. pharyngea*.

2 Terminal branches: *Artt. temporalis* and *maxillar. interna*.

The three anterior and the internal arise below the *m. digastricus*; the two posterior before the entrance into *Parotis*.

543. The anterior branches of the *Carotis externa*.

1. *Thyreoidæ superior*, the superior thyroideal artery supplies the Larynx and thyroid gland with blood.

Or.: close above (sometimes at) the point of division of the *carot. commun.* Course: at first upwards, directly afterwards downwards, several times curved to the superior cornu of the thyroid gland. Position: at first only behind the skin, then behind *mm. omo-, sterno-, hyoideus*, and *sterno-thyreoidæus*.

Branches:

- a. *Art. laryngea superior*, the superior laryngeal artery, arises, sometimes, from the *carotis externa*. Course: transverse between *m. hyo-thyreoid.* and *memb. hyo-thyreoid*, perforates the last (with *N. laryng. sup.*) gives a superior branch to the *Epiglottis* and a descending for *m. thyreo-arytæ-noid*, and the mucous membrane.
- b. *Art. laryngea inf. s. ram. cricothyreoidæus* (Cruveilhier), arises from the internal terminal branch, passes transversely on the inferior border of the thyroid cartilage, anastomoses with that of the other side, and ramifies on the mucous membrane and the muscles of the *larynx*.
- c. *Ram. sterno-mastoideus*, arises under *a*, and passes away downwards over *carotis communis* on the posterior surface of *m. sterno-cleido-mastoideus*.
- d. *Rami thyreoidæi*, three terminal branches. The first passes between thyroid gland and trachea, the second along the external border, the third in the central line before the thyroid gland.
2. *Lingualis*, the lingual artery. Origin: on a plane with the great cornu

of the *os hyoides*. Course: obliquely upwards, then along the superior border of the hyoid bone, forwards and inwards, and thence into muscles of the tongue from behind forwards. Termination: at the tip of the tongue as *Art. ranina*. Position: commences below *m. digastricus*, *stylo-hyoid*, and *n. hypoglossus*; on the *os hyoides* between *m. hyogloss.* and *constrictor pharyng. medius*; in the tongue between *m. genioglossus* and *lingualis* (close to *n. lingualis*.)

Branches:

- a. *Ram. hyoideus*, passes away transversely above the hyoid bone, anastomoses with that of the other side, between *m. genioglossus* and *genio-hyoideus*.
- b. *Art. dorsalis linguae*, small, arises on a plane with the *cornu majus oss. hyoid*, passes upwards to the border of the tongue and to *arcus glosso-palatinus*, forwards and inwards, always close under the mucous membrane, gives branches to the *epiglottis*, *mm. hyo-*, and *stylo-glossus*; lastly, the skin in the region of *papillæ calyciformes*.
- c. *Art. sublingualis*, stronger than the former, passes between *m. mylo-hyoideus* and the mucous membrane, upon the floor of the mouth forwards, along the inferior border of *gland. sublingual.*, external to the *duct. Whartonianus*, supplies these parts, and terminates with a branch above the *frenulum* and a branch for the *foramina incisiva* at the chin.
- d. *Art. ranina s. profunda*, the terminal branch, penetrates above into the thickness of the tongue, between *m. geniogloss.* and *lingualis* (half an inch distant from the back of the tongue), and runs along to the tip, as it gives off internal, external, and superior branches for the muscles and *papillæ*.

3. *Maxillaris externa*, s. *facialis*.—large. Or.: rather higher than *lingualis*, covered by *m. digastric.* and *stylohyoideus*. Course: very serpentine; at first upwards to the angle of the lower jaw, then horizontally forwards in the fossa on the outer surface of *gland. submaxillaris*; towards the middle of the horizontal ramus of the lower jaw it turns over it into the face, passes obliquely upwards to the mouth, nose, and internal angle of the eye, and anastomoses with *Artt. ophthalmica* and *infraorbitalis*. Position: at first between *gland. submaxill.* and *parotis*, along the basis of the lower jaw: externally the skin and lymphatic glands, internally the *gland. submaxillaris*; in the face on the anterior border of *m. masseter*, below covered by the skin (with *m. risorius*), above the angle of the mouth by the *zygomatici* and *levatores labii*, lastly, by much fat and skin.

544. Branches of the horizontal portion.

- a. *Art. Palatina ascendens* (arises sometimes from *Corot. externa* or *pharyngea ascendens*), ascends behind *mm. styloidei*, to the side of the *pharynx*, ramifies in the Tonsils (*Art. tonsillaris*), the soft palate and its arches, anastomoses with *A. pharyngea ascendens*.

b. *Art. submentalis* passes directly forwards, along the (internal) inferior border of the lower jaw, between *mm. myloheid.* and *digastricus*, inclines on the external border of the last (*vent. anter.*) upwards, supplies the skin and muscles of the chin, and anastomoses with branches of *A. dentalis inferior* and *sublingualis*.

c. *Rami glandulares*, 3. and 4. small, supplies *gl. submaxillar.*

d. *Ramus pterygoideus*, small, for *m. pteryg. internus*.

Branches in the face. a. External, supplying the muscles and skin of the cheek; the most distinct are, *ram. massetericus* and *buccinatorius*.

b. Internal.

1. *Art. coronaria s. labialis inferior*, arises close under the angle of the mouth, passes between the muscular and glandular layer, not far from the free edge of the under lip, and anastomoses with that of the other side.

2. *Art. coronaria s. labialis superior*, arises at the angle of the mouth, under *m. levator labii super.*, passes to the upper lip like 1., and gives off from the middle line:

a. *Art. septi mobilis nasi*, which passes to the cartilaginous nasal septum, vertically upwards, and then horizontally under the *sept. mobile*.

b. *Art. pinnalis s. alaris nasi*, at the posterior border of the nasal openings, anastomoses with:

3. *Art. angularis s. nasalis lateralis*, passes upwards from the angle of the nose to the internal angle of the eye, and there unites with *art. ophthalmica* in the *art. frontalis*. It gives the following branches:

a. *Rami pinnales*, 1. at the superior, concave border of the nasal pinna; 2. enters into the nose.

b. *Rami dorsales*, on the back of the nose.

c. *Rami palpebrales*, on the inferior eyelid.

The most remarkable anastomoses of *Art. maxillaris externa* are: a. with *A. dental. inferior*; b. with *A. maxillar. intern.*; c. with *A. ophthalmica*.

545. The posterior branches of *Carotis externa*.

4. *Occipitalis*, the occipital artery,—smaller than 1. and 3. Origin: *Art. maxillar. extern.* or *lingualis*, opposite, sometimes close under, the *Parotis*; covered by *m. digastricus* and *N. hypoglossus*. Course: oblique upwards and backwards, above *proc. transv. atlantis*, under *incisura mastoid.* horizontally backwards, very tortuous. Position: deep, separated in front by *m. stylohyoid.* from *art. auricular. post.* and *carot. externa*. The horizontal portion between *m. rectus lateral.* and *complexus*, then between *obliquus super.* and *splenius*. Divided under *m. splenius* into an external and an internal ascending branch.

Collateral branches: a. *rami cervicales* consist of: 1. for *m. sterno-cleidom.*; enters at the internal surface into the superior part of the muscle, turns round the loop of the *n. hypoglossus*. 2. *Ram. descendens*, between *m. splenius* and *complexus*, divides among the superior layers of the cervical muscles (*m. splen.*,

trachelomast., *complex.*, *biventer cervicis*, *cucullaris*), and in the deeper (*mm. recti* and *obliqui*).

b. *Art. stylomastoidea* (s. *Art. auricular. post.*)

c. *Art. meningea posterior* s. *mastoidea*, enters through *foram. mastoideum* (or *f. occipitale*) for the posterior part of the *dura mater*.

d. *Ram. parietalis*—frequently, enters through *for. parietales* to *sin. longitudinal. superior*. The two ascending terminal branches reach as far forward as the vertex, and are situated between *galea aponeurotica* and the skin.

5. *Auricularis posterior*, the posterior auricular artery, supplies the external and internal ear, the Parotis, narrower than four, arises sometimes in common with it or from it, generally one inch high above it. Course: upwards, in the direction of and external to *proc. styloid.* at first behind and between *m. digastric.* and *parotis*; then covered by *retrahentes auriculæ*, and divides at the anterior border of *proc. mastoideus* into two branches, *ram. mastoideus* and *auricularis*.

Collateral branches: a. *Rami musculares* for *sterno-cleidom.*, *digastric.*, *stylo-hyoideus* and *glossus*.

b. *R. glandulares* for the *Parotis*.

c. *Art. stylo-mastoidea*, enters into the stylo-mastoid foramen, traverses the *canalis Fallopiæ*, meets with a branch of *Art. mening. media* anastomosing at *hiatus can. Fallop.*, gives branches to: *cellulæ mastoid.*, Tympanum (*Art. tympanica superior*), *Memb. tympani* (forming on this with a branch of *Art. temporalis* the *plexus tympanicus*), and to the cochlea (through *fenestra rotunda*).

Terminal branches.

d. *Ramus occipitalis* s. *mastoideus* ascends backwards beneath the skin, passes with a horizontal branch inwards along the superior border of *m. sterno-cleidom.* and *splenius*; with an ascending to the external border of *m. occipitalis* as far as the vertex; supplies *mm. retrahentes* and skin; anastomoses with *art. temporal.* and *occipitalis*.

e. *Ram. auricularis* s. *anterior*, passes upon the posterior surface of the external ear, with a superior and an inferior branch; the last supplies the lobule of the ear, passes in the groove between *helix* and *anthelix*, as it perforates the *concha*.

6. *Pharyngea adscendens*, the ascending pharyngeal artery—the smallest branch of *carotis externa*. Or: from the posterior side of the *carot. externa*, close above the place of division of *carot. communis*; or, on a plane with *A. lingual*. Course and position: vertically upwards, at first between *carotis externa* and *interna*, then behind the last in the triangular space between *pharynx* and *m. pterygoideus internus*; divides into two branches, *art. meningea post.* and *ram. pharyngeus*. Collateral branches: *ram. pharyngeus inferior*, which passes transversely inwards, in ascending and descending branches, and anastomoses with *a. thyreoid inferior*.

Terminal branches.

a. *Art. meningea posterior*, ramify in the *gangl. suprem. N. sympathici*, *Nn. vagus*, *glossopharyng.*, *hypoglossus*, and enters through *foram. jugulare* to the *dura mater* in the *fossa occipital. inferior*; gives a branch which anastomoses with *Art. cervical. adscend.*

b. *Ram. pharyngeus*, continuation of *pharyng. ascend.* Course: before the *carotis interna*, and divides at the *basis cranii*, behind the *pharynx* into several branches, which are reflected and terminate on the *tuba Eustachii*, and in the muscles of the *pharynx*.

546. Terminal branches of the *Carotis externa*.

7. *Temporalis (superficialis)*, the temporal artery. Origin: behind *collum condyli* of the lower jaw and before the *external auditory meatus*. Course: directly upwards, before the ear, over the root of the *process. zygomatic.* of the temporal bone, then in a serpentine direction as far as the centre of the temporal region (or one inch above the *zygoma*) where it divides. Position: at first upon the maxillary articulation covered by *Parotis*, then by the skin and *fasc. parotidea*, only, above *fascia temporalis*.

Anterior collateral branches.

a. *Transversa faciei*, arises (frequently from *carotis externa*) immediately at the *collum condyli*, passes transversely over this and *m. masseter*, covered by *Parotis*, underneath the *zygoma* (inch and a half) and above *ductus Stenonianus* (parallel with it) on to the face; sends a branch for the maxillary articulation, for the *duct. Stenon.*, several *r. masseterici* and ramifies on the anterior border of *m. masseter* into cutaneous branches for the cheeks into muscular branches for *mm. zygomaticus major*, *orbicular. palebr.*, *levat. labii super.*; anastomoses between *artt. temporal.* and *buccalis*, *infraorbital.* and *maxillaris externa*.

b. *Ram. orbicularis*, not always present, arises above the *zygoma*, placed behind *m. orbicularis*, supplies these and anastomoses with *art. palpebral. super.* (see *Art. ophthalm.*)

Posterior branch.

c. *Auriculares anteriores*; the inferior for the lobule of the ear; the central for the auditory meatus; the superior for *helix*, *m. attrahens* and *attollens auriculæ*.

Internal branch.

d. *Art. temporalis media (s. profunda)*, arises close above the *zygoma*, enters into the *m. temporal.* through the deep layer of *fasc. temporal.* and anastomoses with the temporal artery of *Art. maxillaris interna*.

Terminal branches.

e. *Ram. frontalis s. anterior* passes in a curve towards the forehead, and anastomoses with *art. frontalis*, *supraorbital.* and *ram. frontal.* of the other side.

f. *Ram. occipitalis* s. *parietalis*, larger, passes upwards to the vertex and anastomoses with *Artt. auricular.*, *occipitalis* and *ram. frontalis*.

8. *Maxillaris interna* (s. *facialis profunda*). Origin: behind the *collum condyli* of the lower jaw. Course: horizontally forwards, inwards and rather upwards to the *tuber. maxill. super.*, curves forwards and sinks into *fossa spheno-maxillaris*, where it terminates as *spheno-palatina*. Position: at first close behind the *condylus* and before *proc. styloideus*; between *mm. pterygoid. extern.* and *internus* (external to *n. dentalis* and *lingualis*), then between *pterygoid. extern.* and *temporalis*.

547. Collateral branches: A. Arising in the neighbourhood of the *Collum condyli*.

a. *Auricularis profunda* ascends directly, divides into branches for the maxillary articulation, the external auditory meatus (through some foramina in the bones) and the inferior border of the *memb. tympani*.

b. *Tympanica (inferior)*, the tympanic artery, frequently from *Art. temporalis*, small; supplies the external auditory meatus, the maxill. articulation, and enters through *fissura Glaseri* into the *tympanum*, on the anterior wall of which and the *memb. tympani* it anastomoses with *tympanica superior* (s. *stylo-mastoid*).

c. *Meningea media* s. *spinosa*, ascends vertically behind *collum condyli* and *m. pterygoid. extern.* through *foram. spinosum* into the cranium, becomes horizontal and is placed, divided into an anterior and posterior branch, between *dura mater* and the bones of the skull; the anterior ramus ascends from the inferior angle towards the external angle of the *fiss. orbital. super.*, and thence as far upwards as the sagittal suture; the posterior ramus ascends on the *pars mastoid.* of the temporal bone as far as the posterior inferior angle of the parietal bone, and as high as the sagittal suture. Small ramuli pass out of the skull.

1. *Ramul. petrosus*, through *hiatus* into *canal. Fallopiæ* to the *nerv. facialis* and *Art. stylomastoid*.

2. *Ramuli* for *nerv. trigeminus*.

3. *Ramul.* for *m. mallei intern.* through the semi-canal for this.

4. *Rami temporales* for the great wing of the sphenoid bone, anastomoses with the *Artt. temporales profundæ*.

d. *Dentalis* s. *alveolaris inferior*, arises close to the last artery, passes downwards and between *m. pterygoid. intern.* (or rather *lig. maxillare intern.*) and the ramus of the lower jaw through *foram. maxillar. posterius*, and passes through the *canal. alveolar. infer.* as it gives off a twig in the interior of this to each tooth, and many small ones for the diploe of each alveolus. *Art. mylohyoidea* passes from *foram. max. post.* to the inner surface of *ramus maxillar.* in a groove with *nerv. mylohyoid* downwards to *m. mylohyoid*. Through *foram. mentale* a larger branch passes out as *art. mentalis* from the canal, and anastomoses with *art. submentalis* and *coronar. inferior*.

e. *Temporalis profunda posterior* passes between *m. pterygoid. extern.* and

temporal. upwards, to the posterior border of the last, and ramifies in these and the periosteum; anastomosing with *Artt. temporal. profund. anter.* and *media*, and gives, sometimes, *Artt. masseterica* and *buccinatoria*.

f. *Masseterica*, small, passes over *incisura semilunar.* outwards to the *masseter m.*

g. *Pterygoideæ* for *mm. pterygoidei*; some from the *Art. c.* and *e.*; *pterygoid. extern.* gives off, sometimes, a *meningea parva* through *foram. ovale*.

548. B. Arising in the neighbourhood of the *tuber Maxillæ superioris.*

h. *Buccinatoria*, small, passes in a serpentine course from behind forwards, between the ramus of the lower jaw and *m. pterygoid. intern.*, and is lost in *m. buccinatorius*.

i. *Temporalis profunda anterior*, passes to the anterior border of *m. temporalis* (behind the *malar-sphenoidal* suture) upwards, is lost in the last, and sends branches into the fat of the orbit.

k. *Dentalis superior (posterior)* passes downwards in a very serpentine manner to the posterior surface of the upper jaw, below *proc. zygomat.* upon the anterior surface of the former, gives branches to the gums, periosteum, and the superior alveolus, and enters, divided into several branches, through *foram. alveolaria postt.* into the upper jaw for the (superior) molar teeth. Separate branches pass to the mucous membrane of the antrum.

l. *Infraorbitalis*, arises behind *fissura orbital. infer.*, and enters immediately into the *canal. infraorbitalis*, passes through it, and appears at its anterior opening on the face, where the artery ramifies in branches for the exterior and mucous membrane of the cheeks, gums, the corner and incisor teeth, and for the nose, and anastomose with *Artt. maxillaris externa* and *facialis transversi*.

Branches out of *canalis infraorbitalis*.

1. *Ram. orbitalis*, passes with a branch forwards to the inferior eyelid; with another inwards for *ram. palpebral. infer.* of *art. ophthalm.*

2. *Ram. dentalis anterior*, passes downwards between the plates of the upper jaw (anterior wall) to the roots of the cuspids and incisor teeth.

549. C. Arising in the *fossa sphenomaxillaris*.

m. *Vidianæ*, passes backwards through *canal Vidianus* to the superior wall of the *pharynx* and to the *tuba Eustachii*; arises also from the following (as *pharyngea suprema*).

n. *Pterygo-palatina s. palatina superior*, internal and below the former, descends through *can. pterygo-palatinus* behind the upper jaw, through and out of *foram. palati. anteriùs [posterius]* and passes in a serpentine course close to the alveolus forwards on the inferior surface of the palatine vault, until, forming a curve, it meets with the one of the other side at the *canal. incisivus*. Quite above it gives off

1. *Ramuli palatini*; going through *canales palatini post.* to the soft palate.

2. Branches for the glands and mucous membrane of the palatine vault.
 3. *Ram. nasalis* enters through *can. palatinus anter.* into the nasal cavity.
 o. *Art. spheno-palatina s. nasalis posterior*, the terminal branch of *Art. maxill. intern.*, passes, curved, transversely inwards through *foram. spheno-palatinum* into the nasal cavity, and divides behind the superior nasal chamber into:

1. *Art. septi narium s. nasopalatina*, which passing obliquely inwards, downwards, and forwards, between the nasal septum and mucous membrane, it divides into a superior and inferior branch, and anastomoses with *art. palat. super.* in the *canalis incisivus*.
2. *Art. nasalis posterior*, enters behind the middle *concha* into the nose, descends upon the internal surface of the palate bone forwards, perforates the inferior *concha*, and enters the inferior nasal chamber.
3. *Art. pharyngea descendens* passes in a canal (internal to *vidian*) at the base of *proc. pterygoid.* backwards to the superior part of the nasal cavity and the *pharynx*.

Art. maxillaris interna, thus sends branches:

1. To the organs of mastication, as: *Artt. dentales, infraorbitalis; masseterica, temporal. profunda ant. and post. pterygoidea.*
2. To the organs of deglutition: *Artt. palatina super., vidiana, pharyngea.*
3. To the cavities of the nose: *Artt. infraorbitalis, spheno-palatina.*
4. To the organs of audition: *Art. tympanica, auricularis prof., rami art. meningæ mediæ.*
5. To the face: *Artt. buccinatoria, infraorbitalis, mentalis.*
6. To the cranial cavity: *Art. meningæ media.*

550. II. *Carotis interna s. Cerebralis*, the internal Cranial Artery.

It supplies the anterior portion of the brain and the eye. Course: from the point of separation of the *carotis communis* as high as the *m. digastricus* (posterior belly), almost parallel with *carotis externa* and a little curved; thence to the entrance into the *canal. caroticus* deeper backwards and inwards, in a triangular space between *pharynx* and *ram. maxill. infer.*; before the entrance horizontal. In the *canal. caroticus* it makes four curvatures, as at first it ascends vertically, then passes (first curve) horizontally forwards and inwards as far as *sinus cavernosus* to the apex of the temporal bone, comes forth and (second curve) ascends at a right angle by the side of *sella turcica*, passes again horizontally (third curve) as far as *proc. clinoid. anter.*, and (fourth curve) perforates the *dura Mater* obliquely upwards, backwards, and somewhat inwards, on the outer side of the optic nerves. Situation: in the

neck, behind *mm. stylo-glossus* and *pharyngeus*, separated by these from *carotis externa*; before *m. longus colli* and the vertebral column; internally, bounded by the lateral wall of the *pharynx*, *art. pharyngea ascend.* and *gangl. I. N. sympathici*, externally by the ramus of the lower jaw, *V. jugularis interna* and *Nn. vagus, glosso-pharyng., hypo-glossus* (which lie behind it above); in the *canal. caroticus*: surrounded by filaments from *ganglion cervicale supremum* and by a thin sheath; in the *sinus cavernosus*: on the inner side of *nerv. abducens, oculo-mot., pathetic.*, and *ram. ophthalm.* of the fifth nerve.

Branches: As an exception, the *Artt. pharyngea ascendens* and *temporalis* pass off from the cervical portion, otherwise none; inside the *canal. caroticus* a small branch for the *tympanum*; in the *sinus cavernosus* several small branches for the basilar portion of the *dura mater*, the walls of *sinus petrosus infer.*, for the *hypophysis cerebri*, *N. trigeminus*, and a connecting branch to the *Art. mening. media*. Besides, anteriorly: *Art. ophthalmica*, and the terminal branch of *carotis interna*; these are, *artt. communicans, choroidea, corporis callosi, fossæ Sylvii*.

551. 1. *Ophthalmica*.—Origin: close behind *proc. clinoid. anter.* from the convex anterior surface of the fourth curve of the *carotis*. Course: enters immediately below the optic nerve, through the *foram. opticum* into the orbit, passes at first on the outer and lower side of the optic nerve, between *musculi rectus super. and externus*, then inwards above *n. opticus* as far as the internal wall of the *orbita*; lastly, directly forwards along the inferior border of *obliq. superior*, and under the *trochlea*, and divides at the place of junction of the upper jaw and frontal bone, into *Art. nasalis* and *frontalis*.

Collateral branches: Arising on the *outer* side of the *Nervus Opticus*.

a. *Lacrymalis*, the lacrymal artery, large, arises immediately as the *Art. ophthalm.* enter the *orbita* (or as it crosses the optic nerve), passes on the external wall between *periorbita* and *m. rect. extern.*, as far as the lacrymal gland, ramifies here and gives off branches to the superior eyelid, *m. rect. extern., super.*, to *Art. mening. med.* (backwards), to the temporal (through *for. zygomatic.*)

b. *Centralis retinae*, thin; penetrates into the centre at the inferior side of the optic nerve, passes in its axis directly forwards, spreads out with three diverging branches on the internal surface of the *retina*. A branch passes from it in the axis of the eye; this is,

Capsularis, through the vitreous body as far as the posterior wall of the capsule of the lens, giving off on the way minute *ramusculi*.

Arising above the Optic Nerve.

c. *Supraorbitalis*, arises where the ophthalmic artery crosses the optic nerve, passes between the roof of the *orbita* and *m. levator palpebr. sup.*, passes through *foram. supraorbital.*, upwards, and divides into an external and internal branch, ascending upon the frontal bone, for *corrugat. orbicular.* and *frontalis* and skin of the forehead.

d. *Ciliares* (for. *choroidea*, *corp. ciliare* and *iris*).

1. *Posticæ s. breves*, arise, often from a superior and inferior common trunk, pass along the optic nerve in a tortuous manner, surrounding it in clusters, perforate the *sclerotica* with it, and spread out in the *choroidea* and *proc. ciliares*, with ten to twenty branches.
2. *Mediæ s. longæ*, an external and an internal; they perforate the *sclerotica* rather farther from *N. opticus*, pass between *sclerotica* and *choroidea* as far as *lig. ciliare*, where they divide, unite to form *circulus iridis major*, out of which also the *circulus iridis minor* arises.
3. *Anticæ* (six to twelve branches of the *Artt. musculares*, or *lacrymalis* and *supra-orbitalis*), give some branches to the fascia, perforate the *sclerotica* not far from the *cornea*, and open into the *circulus iridis major*. Their number is indefinite.

e. *Rami musculares*, a superior smaller (sometimes wanting), supplies *mm. levator palpebr.*, *rectus* and *obliquus superior*; an inferior passes between *n. opticus*, and *m. rectus inferior* supplies this, and *rect. externus* and *obliq. inferior*; gives off *ciliar. anticæ*.

Arising on the inner side of the Optic Nerve.

f. *Ethmoidales*, a posterior and an anterior (larger), pass under *m. obliq.*, through the *foram. ethmoidalia* out of the orbit into the cranial cavity, divide (each) upon the superior surface of the cribriform plate into two branches for the *dura mater* and nasal cavities. The anterior gives;

1. *Meningea antica*, for the *falx cerebri*, along the coronal suture.
2. *Nasalis anterior*, passes through an anterior foramen to the anterior part of the labyrinth and the septum and anastomoses with branches of the *Spheno-palatina*.

g. *Palpebrales s. tarseæ*, arise close before the *trochlea*. The inferior passes behind *lig. palpebr. intern.* downwards and outwards, and passes close to the free border of the lid, between the cartilage and muscle of the inferior eyelid as far as the outer angle, forming an arch (*arcus tarsus infer.*) and anastomosing with the *lacrymalis* and *infraorbitalis*, where a branch for the mucous membrane of the nasal canal then passes off. The artery of the superior eyelid descends to the superior lacrymal punctum, then passes outwards, like the inferior (*arcus tarseus superior*), and anastomoses with the *lacrymal, frontalis, temporal. superfic.*

h. *Nasalis (s. dorsalis nasi)*, terminal branch of *ophthalmica*, on the internal superior angle of the *orbita*, passes out of these over *lig. palpebr. intern* into the face, and divides after it has once given off:

1. *Art. sacci lacrymalis* to the mucous membrane of the lacrymal sac, into
2. *Angularis*, which passes between *m. pyramidalis nasi* and *levat. labii sup.*, and anastomoses with the *maxillar. externa*. (See that artery.)
3. *Dorsalis nasi*, passes upon the back of the nose under the skin transversely below the forehead, extends downwards, often to the middle of the nose, and anastomoses on the *nasal pinna* with *Art. alaris nasi*.
- i. *Frontalis*, the terminal branch of *ophthalmica*, smaller than *h*, passes parallel with *A. supraorbitalis* upwards to the forehead, where it divides into branches for the skin, the muscles, and the periosteum, and anastomoses with *art. temporalis*.

552. 2. *Art. cerebri anterior s. corporis callosi*, passes away above *n. opticus*, behind the root of *olfactorius*, (forwards) and inwards towards the middle line, and in the fissure between the two anterior cerebral lobes on the inferior surface of the brain; here, a stronger, short (two lines) transverse branch unites the two anterior cerebral arteries, *ram. communicans anterior*. Each artery then turns round the anterior border of *corp. callosum*, passes upon its superior surface to the posterior border, and terminates with a small branch curved upwards in the neighbouring convolutions. Branches: to *nn. opticus*, *olfactorius*, to *ventriculus tertius*, to the inferior and internal surface of the anterior cerebral lobes, to *corp. callosum*.

3. *Art. cerebri media s. fossæ Sylvii* passes externally and internally into *fossa Sylvii*, divides into three branches for the anterior and middle cerebral lobes, and anastomoses with *Art. cerebri anterior* and *posterior*. Small branches pass directly from below upwards to the *corp. striatum*. Is larger than 2. and 4.

4. *Art. s. ramus communicans (posterior)*, arises from the posterior part of *carotis intern.*; passes under *tractus n. optic.* backwards (one half to three quarters of an inch long), and forms with *art. cerebri posterior* (s. *Art. vertebralis*) the *circulus arteriosus Willisii*.

5. *Art. choroidea* arises above the former, passes outwards and backwards with the *tractus n. optico*r. below the *crus cerebri*, enters into the lateral ventricle, on the *cornu ammonis* around the *thalamus*, and ramifies in the vascular plexus, *plexus choroideus* of the third [lateral] ventricle.

All the arteries of the brain take a very tortuous course.

553. B. *Subclavia*, the subclavian artery.

Origin: the right from the *truncus anonymus*; the left from the *arcus aortæ*. (The right frequently arises below the left, at the posterior inferior part of the *arcus aortæ*, and betakes itself to the right behind *trachea* and *æsophagus*, sometimes between the two). Course: ascends as high as the apex of the lungs, curves over the first rib, and passes between *scalenus anticus* and *medius*, outwards and downwards to the axillary cavity. The right is shorter, thicker, and inclines less upwards than outwards. Situation: first portion, from the origin to *m. scalenus anticus*.

The right is covered before by *m. sterno-thyreoid.*, *ven. anonyma*, *n. vagus* and *phrenicus*, *m. cleido-mastoid*, behind, separated by *n. recurrens* from *m. longus colli*; bounded internally, only a little, by *v. cephalica*, covered externally by the *pleura*; surrounded all round by lymphatic glands, loose uniting tissue, and *plexus* of *n. sympathicus*.

The left passes parallel with *v. cephalica*, lies immediately upon *longus colli*; and is covered to a greater extent by the *pleura*; otherwise like the right.

The second portion lies close above the centre of the first rib in the space between the *mm. scaleni*; below the two *scaleni*; before the *plexus brachialis*; behind *scalen. anticus*, before which *v. subclavia* lies.

The third portion reaches from the outer border of the *scalenus antic.* to the clavicle, lies in the triangular *fossa supraclavicularis*; behind *ven. subclavia*, *m. subclavius* and *clavicula*; before *plexus brachialis*; under *m. platysmam.*, skin [*supra-clavicular. nerves*], and the obliquely crossing *art. et ven. suprascapularis*; over the first rib.

554. Superior branches of *Art. subclavia*.

1. *Art. vertebralis*, the vertebral artery, the largest branch of the *subclavia*, supplies the spinal cord, *medulla oblongata*, the small and the posterior parts of the great brain. Or: at the superior, posterior wall of the *subclavia*, at the commencement from the arch. Course: vertically upwards and rather backwards, it enters between *proc. transvers.* of the sixth cervical vertebra into the *canalis vertebralis*, and ascends, slightly curved, to the second, turns backwards between this and the *atlas*, more still between *atlas* and *foramen magnum* behind *proc. condyloid. occipit.*, and enters the skull through *lig. obturatorium* and *dura mater*, round to the front of *medulla oblongata*, ascends upon *pars basilaris*, and unites with the *art. basilaris* of the other side. Position: at first very deep between *m. longus colli* and *scalenus antic.*, behind *art. thyreoid. inferior*, then in *canal. vertebralis*, in the interspaces covered by *mm. intertransversarii* and before the *nn. cervicales*; the first curvature between *m. trachelomastoid.* and *obliq. infr.*; the second between *obliq. sup. rectus capit. minor* and *lig. obturatorium*; in the cranial cavity: at the sides and before *medulla oblongata*.

Branches. In the neck:

- a. *Rami spinales* pass through the *foram. intervertebral.* to the spinal cord. Several come from *art. cervicalis* and *pharyngea ascendentes*.
- b. *Rami dorsales* pass to the deep cervical muscles above the transverse pro-

cess: anastomosing with *art. occipitalis* and *cervical. profunda*; a larger branch.

Art. meningeæ posterior enters through *foram. magnum* to the *falx cerebelli*.

In the cranial cavity :

- c. *Art. spinalis posterior*, arises at the sides of *medull. oblong.* and divides into an ascending branch for the walls of the fourth cerebral ventricle, and a descending which passes down on the posterior surface of the spinal marrow, becomes enlarged by the *rami spinales* passing into it, and is thus continued as far as the inferior extremity of the vertebral column. It gives an anterior and posterior branch for the posterior roots of the *nn. spinales*.
- d. *Art. spinales anterior*, larger than the former, arises close under the *art. basilaris*, associates with that of the other side, passes in a groove on the anterior surface of the spinal cord, as *art. mediana*, as far downwards as the *os coccyx*, continued by branches of *cervical. ascendens, vertebralis, intercostales* and *lumbales*.
- e. *Art. cerebelli inferior posterior*, arises on the outer wall of *vertebral.*, curves round before the roots of the *vagus* and *hypoglossus*, backwards round the *medulla oblong.*, passes forwards between the central and lateral lobes of the *cerebellum*, and divides into an internal and external branch, the last of which ramifies on the inferior surface of the *cerebellum*, and anastomoses with *art. cerebelli*.

555. *Art. s. truncus basilaris*, the continuation of the two *Artt. vertebrales*, commences in the sulcus between *medull. oblong.* and *Pons Varolii*, and terminates on the anterior border of the last. Its inferior wall rests upon the *clivus*; its superior wall gives numerous branches to the *Pons Varolii*; from the lateral walls arise :

- f. *Art. cerebelli inferior anterior* arises in the middle of *art. basilar.*, passes outwards under *nerv. facialis* and *acusticus* to *lobul. anterior cerebelli*.
 - 1. *Auditiva interna* passes off from it, or the *basilaris* itself, and goes with *nerv. acusticus* to the *cochlea* and *vestibule*.
- g. *Art. cerebelli superior* arises close to the anterior extremity of *art. basilaris*, behind *n. oculo-motorius*, turns round *pedunculus cerebri* upon the superior surface of *Pons Varolii*, and supplies, divided into an external and an internal branch, the borders and superior surface of the *cerebellum*.
- h. *Artt. cerebri posteriores s. profundæ*, the two terminal branches of *basilaris*, pass forwards, diverging, bend backwards upon the superior [inferior] surface of *pedunculi cerebri* to the inferior of the posterior lobes of the brain; give, quite at the commencement, numerous branches to the *substant. perforata grisea* between the crura of the brain; receive *ramus communicans*, which passes off from *Carotis interna*, and thus completes the

heptangular *circulus arteriosus Willisii*, which lies over the *sella turcica*, and surrounds the *hypophysis cerebri*. It is formed: the anterior transverse wall by *ramus communicans anter.*, the anterior, central, and posterior lateral walls by *Artt. cerebri anter., communicant. posterr., cerebri profundæ*.

556. 2. *Art. thyreoideæ inferior*, in the child larger, is sometimes wanting. Origin: close and next to *art. vertebr.*, rather external (frequently in common with *supra-scapularis*, as *thyreo-cervicalis*). Course: first upwards to the lateral border of the thyroid cartilage. Position: before the first curve, *carotis communis*, *ven. jugular. intern.*, *n. Vagus*, and *sympathicus* (*ganglion cervicale med.*); before the second curve, *nerv. recurrens*; behind it, *art. vertebral.* and *longus colli*; *œsophagus* (to the left). Branches: to *œsophagus*, *trachea*, *m. scalenus antic.*, and *longus colli*. Farther:

- a. *Cervicalis ascendens*: ascends before *scalen. antic.*, then between it and *rectus capit. antic.* directly upwards to the *basis cranii*, gives *rami musculares*, and especially *rr. spinales*, which anastomose with the *vertebralis*. With it is generally united:

art. cervicalis superficialis (into a common trunk; *thyreo-cervicalis*). Course: transversely outwards through the *fovea supraclavicul.*, to the border of *cucullar*. Position: before *scalen. antic.*, *plex. brachial.*, *levator scapul.*, and *omo-hyoideus*, one inch above the clavicle, higher than the *suprascapularis*; supplies *cucull. scap.*, *splenii*, *levator*, &c.

- b. *Laryngea inferior* (s. *thyreoidea superior*, see before).

- c. Terminal branches, three; 1, at the inferior border; 2, at the sides of the posterior surface of the thyroid gland; 3, at the inferior border of *cartil. cricoidea*.

Art. thyreoidea infima (Neubauer) is not always present; arises from *arcus aortæ*, *carotis communis*, or *thyreoid. inferior*; passes before the *trachea* to the gland.

557. Superior external branches of the *Subclavia*.

3. *Scapularis posterior* (s. *transversa cervicis*). Origin: generally outside *Scaleni* (or inside, in common with *thyreoidea infer.*; or between them, in common with the *suprascapular.*). Course: transversely outwards through *plexus brachialis*, curving backwards towards the superior posterior angle of the scapula; divides into:

- a. *Cervicalis suprema*; ascends under the *cucullar.*, ramifying in it, *levator scap.*, and *splenius*.
- b. *Dorsalis scapulæ* winds under the *levator* and the angle of the *scapula*, descends along the spinal border to the inferior angle between *rhomboid.* and *serratus post.*, and anastomoses with *suprascap.* and *scapul. inferior*.

Situation: at first horizontally in the *fossa supraclavicular.*, covered by *platysmamyoid.*, *omohyoid.*, later by *cucullaris* and *levator scapulæ*.

- 4. *Suprascapularis* s. *transversa scapulæ*. Or.: below *art. thyreoid. inferior*

(in common with it and *cervical. superfic.*, when the last arises internal to *mm. scaleni*). Course: obliquely outwards and downwards under *cervical. superficial.*, behind the clavicle, above the superior border of the scapula (over *lig. incisuræ semilunaris*) to the fossa *supra-* and *infra-spinata*. Situation: at first covered by *sterno-cleidom.*, then by *subclavius*, before *scalen. anticus*, *art. subclavia*, and *plex. brachialis*, above *ven. subclavia*, afterwards under *trapezius*; on the *scapula* between the bone and *supraspinatus*. Branches to *subclavius*, *trapezius*, *supra-* and *infra-spinatus*, and periosteum of *acromion*.

5. *Cervicalis profunda*. Or.: the furthest outwards, in common with *art. intercostal. prima*. Course: upwards and backwards, then outwards between *proc. transvers.* of the seventh vertebra and the first rib, upwards upon *multifidus* and *semispin. cervicis* as far as the *atlas*; a branch descends to the middle of the back between *longissimi dorsi*. Situation: behind *scaleni*, then deeper. Branches: to the deep layers of cervical muscles.

558. Inferior branches of the *Subclavia*.

6. *Intercostalis prima*, supplies the first and second (and third) intercostal space. Or.: behind, under *A. cervical. profunda*. Course: passes before the neck of the first rib, curving backwards and downwards on the outside of *gangl. dorsale*, to the inferior border of the first (and second) ribs. Branches:

- a. *Ramus dorsalis*; passes backwards, sends a *ramus spinal.* through *foram. intervertebr.*
- b. *Ram. intercostalis* passes forwards between *mm. intercostales*.

7. *Mammaria* (s. *thoracica*) *interna*, the internal mammary artery. Or.: in front under *Art. thyreoid. inferior*. Course: vertically downwards behind the sternal extremity of the *clavicula* and the cartilages of the first to the sixth ribs, where it divides into an external and an internal branch. Situation: at first behind *m. scalenus antic.* and *n. phrenicus*, then upon the inner side of the last, a line and a half to two lines from the border of the sternum, before *m. triangular. sterni* and *pleura*.

Branches. 1. Posterior, in the chest.

- a. *Artt. thymicæ*, in children very large, to the *Thymus*.
- b. *Art. phrenica superior*, with *N. phrenicus*, passes between pericardium and anterior mediastinum to the diaphragm. Branches to the *pericardium*, *Thymus*.

2. External branches of the *mammaria interna*.

- c. *Artt. intercostales anteriores*; the two pass to the superior and inferior borders of the first and second intercostal spaces; supply *mm. intercost.* and *pleura*, anastomosing with *artt. intercostales posterr.* (see *Aorta*).

3. Anterior branches of *mammaria interna*.

- d. *Artt. mammariæ externæ* (six to seven) pass directly from behind for-

wards, perforate the *mm. intercostales*, and divide into muscular and cutaneous branches (for *mm. pectoralis* and *intercostales*); the superior pass to the thoracic glands, and are very greatly developed in *mammalia*. Some branches (*r. sternaes*) go into the *periosteum* of the *sternum*; others perforate the last.

559. The terminal branches of the *mammaria interna*.

e. *Musculo-phrenica* passes obliquely outwards and downwards, behind the seventh to the eleventh rib cartilage, before the diaphragm; terminates in the twelfth intercostal space, and gives besides, for the seventh to tenth, the *artt. intercostales anterr.* Anteriorly: branches for the diaphragm and *mm. obliqui abdominis*.

f. *Epigastrica superior*, smaller, passes out behind the seventh rib cartilage from the chest; passes behind and in the sheath of *m. rectus* as low as the *umbilicus*, there ramifies, and anastomoses with the capillary rete of *art. epigastrica (inferior)*; a branch passes in the form of an arch upon the anterior surface of *process. xiphoideus*.

560. *Axillaris*, the Axillary artery,

a continuation of the *a. subclavia*, reaches from the clavicle as far as the inferior border of the *m. pectoralis major*, passing in the oblique diameter of the axillary cavity.

Situation: surrounded by lymphatic glands and loose uniting tissue behind: *m. subclavius*, *pectoralis major* and *minor*, lastly, *m. coraco-brachialis*; before: the uniting tissue between *m. subscapular.* and *serratus posticus major*; farther down before *m. teres major* and *latissimus dorsi*. Internally, it rests, at first, upon the first rib and first intercostal space, then at a distance from the thorax, and is only covered by fascia and skin; on the outer side is situated: *caput humeri (m. subscapular.)*.

Close under the clavicle we find *ven. axillaris*; internally, *vv. cephalica* and *acromialis* before *art. axillaris*; *plexus brachialis* externally, one *n. thoracicus* before it, farther down *n. medianus* and *cubitalis* before, *n. radialis* behind it. We find the *axillaris* at the superior external border of the growth of hair in the axillary cavity. Branches: three *thoracici*, one *subscapular*, two *circumflexæ*.

561. Above the *pectoralis minor*:

a. *Thoracica l. s. suprema* arises from the inner side of *a. axillaris*; passes over the superior border of *m. pectoral minor* downwards and inwards between *mm. pectoral. major* and *minor*, and ramifies in them. Anastomoses with the *sup. intercost.*

b. *Thoracica II. s. acromialis* arises generally in common with *a* and divides into :

1. *Ram. deltoideus*, which passes close to *Ven. cephalica* downwards in a groove of uniting tissue between *m. pectoralis* and *deltoideus*, and terminates in the last.
2. *Ram. acromialis* passes away, covered by *m. deltoideus*, transversely outwards, above *proc. coracoid.*, *lig. coraco-acromiale*, and the external extremity of the anterior border of the *clavicula* to the shoulder-joint ; anastomoses with *transvers. scapulæ*.

562. Below the *pectoralis minor* :

c. *Thoracica III., s. longa, s. inferior, s. mammaria externa*, passes downwards and forwards on the side of the thorax between *m. pectoral. major* and *serratus magnus*, then between this and the skin, terminating on the sixth intercostal space ; it gives branches to the axillary and mammary glands, the muscles of the second to the sixth intercostal spaces.

563. Branches of the *axillaris* at the *collum humeri*.

d. *Subscapularis*. The largest branch of *axillaris* arises from the outer side of it between *N. radialis* (within) and *N. medianus* (without). Course : curved outwards and downwards, parallel with *m. teres major*, on the anterior (external) border of the *scapula*. Position : before *m. scapularis*. Branches : to *m. scapularis*, *teres major*, and two terminal branches.

1. *Art. thoracico-dorsalis* passes downwards along the anterior border of the *Scapula*, behind *Art. thoracica longa*, between *latissim. dorsi* and *serratus anticus*, and ramifies in them.
2. *Art. circumflexa scapulæ*, before the long head of *m. triceps*, turns round the attachment of this to the anterior border of the *Scapula* backwards to the *fossa infraspinata*, covered by *m. infraspin.*, sends an anterior branch between *fossa* and *m. subscapularis*, and anastomoses with *art. transversa scapul.* (above) and *thoracico-dorsalis* (below).

e. *Circumflexa humeri anterior*, small, arises on the anterior outer side of *axillaris*, often in common with the following. Course : transversely outwards above the tendons of *latissim. dorsi* and *teres major*, around the anterior surface of *collum humeri* backwards. Situation : behind *coracobrachial.* and *biceps*. Branches to *collum humeri* [and head, gives off the epiphysial artery.]

f. *Circumflexa humeri posterior*; larger. Origin : at the posterior outer side of *axillaris*, opposite to *subscapularis*. Course : transversely backwards and outwards round the posterior surface of *collum humeri* to the outside of it ; terminates in *m. deltoideus*. Situation : close to *Ven. circumfl.* and *Art. axillaris*, before *cap. long. m. tricipitis*, *latissim. dorsi*, above *teres*

major, below *teres minor*, behind *os humeri*. Branches to the articular capsule, periosteum, and *m. deltoideus*.

564. *Brachialis*, the Brachial artery.

Continuation of *axillaris*, reaches as far as the fore-arm, where it bifurcates. Course: extends downwards first on the internal, then on the anterior surface of the upper arm, so that it is situated in front of the elbow-joint in the centre of the flexure. Situation:

565. 1. In the upper arm:

covered in front and above by *m. coraco-brachialis*, then by the internal border of *m. biceps*; behind and above by *m. triceps*, then by *brachialis internus*; internally by *fascia brachialis* and skin; externally accompanied by *m. coraco-brachialis* and the internal surface of the *Humerus*; in a common sheath with *n. medianus*.

Vv. brachiales lie on both sides; *N. medianus* above on the outside, in the middle in front, below on the inner side; *N. cubitalis* above on the inner side; *N. radialis* behind the brachial artery.

566. 2. In the flexure of the arm:

separated before by *v. mediana*, *aponeurosis bicipitis* from the skin; behind by *m. brachialis internus* from the joint; on the inside of the tendon of *m. biceps*; on the outside of the *n. medianus* and *m. pronator teres*.

Branches sixteen to twenty; external anterior for *mm. coraco-brachial.*, *biceps*, *brachial. intern.*, and *deltoid*; internal posterior for *m. brachial. internus*.

Nutritia humeri arises from a muscular branch, or from *profunda brachii*, enters into the foramen above the centre on the inner side of the humerus. Also the following:

1. *Profunda brachii*. Or.: often in common with *circumfl. poster.*, on the inferior border of *teres major*. Course: downwards and backwards, close to *N. radial.*, round the posterior circumference of *os humeri*, in a groove which it abandons under the attachment of *m. deltoid.*, and divides into a deep and superficial branch. Situation: between *os humeri* and *m. triceps*, then between *triceps* and *brachial intern.* Branches:

a. *Collateralis radialis profunda*, accompanying the *n. radialis*, between *cap. intern.* and *extern. tricipitis*; supplies these; anastomoses with 2.

b. *Collateralis radialis superficialis* passes directly downwards along the *lig. intermuscl. extern.* behind the *condyl. extern.* and anastomoses with *a. recurrens radialis*.

2. *Collateralis ulnaris superior (prima)*, [*s. profunda inferior*] arises close next to or from the *profunda brachii*, passes downwards on the inner side of

triceps, perforates the *lig. intermusc. intern.* (with *n. cubital.*), and reaches as far as the articulation, where it supplies the *triceps* and *brachial. intern.*

3. *Collateralis ulnaris inferior* [*s. anastomodica*], arises above the elbow, passes obliquely downwards and inwards, towards *condyl. hum. intern.*, and is lost in *rete articulare cubiti*, *m. brachialis* and *pronator teres*.

The brachial artery bifurcates commonly (half an inch) below, sometimes in, frequently also above the flexure of the arm into *art. radialis* and *ulnaris* (at the inferior or superior third of the upper arm, indeed, even in the axillary cavity. Cruveilhier.)

567. I. *Radialis*, the radial artery,

the external, smaller, and more superficial branch of *art. brachialis*, passes directly downwards, and rather obliquely outwards, along the internal border of the *radius*, as far as the articulation of the hand, turns round the *proc. styloid radii* and *os naviculare* upon the dorsal surface of the *carpus*, and immediately again between the first and second metacarpal bones forwards into the hollow of the hand, and forms the *arcus volaris profundus*. Situation :

a. From the commencement to the *carpus* : behind the internal border of *m. supinator longus*, below covered only by the *fascia* and skin ; upon *m. supinator brevis*, *pronator teres*, *flex. digit. sublim.*, *long. pollic.*, *pronat. quadrat.*, then close upon the bone on the inner side of the tendon of *m. supinator longus* and the *n. radialis*.

b. On the *carpus* : covered obliquely by the tendons of *abductor pollic. long.*, *flex. long.*, and *brevis*, close upon the bones.

c. In the hollow of the hand (see *arcus volaris profundus*.)

Variety. It frequently inclines to the back of the fore-arm at a point higher up (two or three inches above the *carpus*.)

Besides many (forty) muscular branches and a *transversa carpi volaris* to the *rete carpeum volare*, the radial artery yet gives off the following branches :

1. *Recurrents radialis*.—Origin:—behind, close to the commencement of *art. radialis* (also from the *brachialis*). Course: runs outwards and upwards to *condylus externus*. Situation: between *supinat. long.* and *brevis* (above *brachialis intern.*). Anastomoses with *profunda humeri*. Branches: from the convexity downwards and outwards to *mm. supinatores* and *radiales extern.*; to the *rete articulare cubiti*.
2. *Ramus volaris superficialis*, *s. radio-palmaris*. Or.: above *os naviculare* from the inner side of *art. radialis*. Course: passes over the origin of *abductor pollic. brevis*, on the external border under *aponeurosis palmaris* to the *arcus volar. sublimis*. Branches to the muscles of the thumb, or even to the outer side of the middle and the two sides of the index fingers.

3. *Ramus dorsalis*, the termination of *art. radialis* upon the back of the carpus (see above), gives off:

a. *Transversa carpi dorsalis*, passes transversely over the middle of the back of the carpus, inwards, to the *rete carpeum dorsale*; anastomoses with *a. ulnaris*, and gives off ascending and descending branches.

b. *Interossea II. s. metacarpi dorsalis*, passes between the second and third metacarpal bones, passes at the inferior extremity forwards to the *arc. volaris sublimis*, where two branches are then given off:

1. *Art. dorsalis radialis digiti medii*, for the external border of the middle finger.

2. *Art. dors. ulnaris indicis*, for the internal border of the thumb.

c. *Interossea I.*, passes between the first and second metacarpal bone, and gives off:

1. *Art. dors. rad. indicis* for the radial border of index finger.

2. *Art. dors. ulnaris pollicis*, for the ulnar border of thumb.

d. *Princeps s. magna pollicis*, passes between the muscles of the ball of the thumb and the volar side of the first metacarpal bone to the first phalanx on the radial side.

Rete articulare cubiti, the anastomosis about the elbow-joint, is formed:

1. Above by *collateralis radialis*, *ulnaris superior* and *inferior*.

2. Below by *recurrens radialis*, *ulnaris*, and *interossea* (which see.)

568. II. *Ulnaris s. cubitalis*, the ulnar artery,

the internal, larger branch of *brachialis*, at first slightly curved upwards and backwards, it passes backwards and inwards, then (three lines from the origin) extends downwards on the anterior surface of the *Ulna* as far as the carpal articulation; hence, on the outer (radial) side of *os pisiforme*, above the *lig. carpi volare propr.* to the hollow of the hand in the *arcus volaris sublimis*. Position: at first deep behind *mm. pronat. teres, flex. carp. radial, palmar., flex. dig. sublimis*, and *N. medianus*, then superficially, between the tendons of *flex. sublim.* (outside) and *carpi ulnaris* (inside); upon *m. brachial. intern., flex. profund.,* and *pronator quod.*, the *ulna*; on the outer side of *Nerv. ulnaris*; at first outside, then behind, at last inside *N. medianus*. Branches to the muscles; also:

1. *Recurrens ulnaris*.—Origin: from the posterior wall, one inch from the origin of the *ulnaris*. Course: deeply under the muscles towards the inside, between *condyl. internus* and *olecranon*, upwards to the *rete articulare cubiti*.

Position: covered by *pronator teres*, *flex. sublim.*, *palmar long.*, *flex. carp. ulnar.*, passing before *N. ulnaris*. Branches: a. an anterior between *pronator teres* and *brachialis internus*; b. to *N. ulnaris* above.

2. *Interossea*.—Origin: from the *ulnaris* behind, close under the last. Course: directly backwards and downwards, to the centre of the fore-arm; it bifurcates into:

a. *Interossea anterior* (s. *interna*).—Origin: above *lig. interosseum*. Course: on the anterior surface of *lig. interosseum*, between *flex. digit. profund.* (inside), *pollic. longus* (outside), perforates under *pron. quadrat.* the *lig. inteross.*, and passes upon the dorsal surface of the *carpus* into the *rete dorsale*. Branches: several *artt. perforantes* pass through *lig. inteross.* backwards to the deep muscles; an anterior superior branch accompanies the *nerv. medianus* as far as the hand; an inferior passes behind *pronat quadratus* downwards to the *rete carpi volare*.

b. *Interossea posterior* (s. *externa*); smaller than the last; passes through two inches below the articulation between *ulna* and *radius* upon the dorsal region of the fore-arm, and divides immediately into:

1. *Interossea recurrens* (s. *radial. poster.*); ascends on the radial side of the *ulna*, covered by *anconeus parvus*, to the *rete cubitale*.

2. *Interossea descendens*, descends, nearer to the *ulna*, upon the dorsal side of *lig. inteross.* as far as the *carpus*. Branches to *extens. commun. digit. 5*, *carp. ulnaris* and skin.

3. *Art. nutritia ulnaris*, a small branch, about the middle of the *art. ulnaris*, passes through a *foram. nutritium* in the *ulna* [from below upwards]; sometimes also a branch to the *radius* (or even from the anterior circumference of *interossea anterior*).

4. *Ramus dorsalis*, terminal branch of *ulnaris*, passes under the tendon of *m. flex. carpi ulnaris* to the back of the *carpus* into the *rete carpi dorsale*; giving off in its passage the *dorsal. ulnar.* to the little finger.

5. *Ramus volaris*, terminal branch of the *ulnaris*, passes close to *os pisi-forme*, and above *os hamatum* (*hamulus*) and *lig. carp. propr.*, covered by *aponeurosis palmar.* and *m. palmar. brevis*, into the hollow of the hand, gives branches to the muscles of the ball of the little finger, and

a. *Ram. sublimis*, which externally passes into *arc. volaris sublimis*; and,

b. *Ram. profundus*, which gives off an internal branch for the *volar* surface of the little finger, and under the tendons of *mm. flexor. digit.* goes to form *arc. volar. profund.*

569. The vascular arches of the hand.

1. *Arcus* (s. *rete*) *carpi dorsalis*, is situated upon the dorsal surface of the metatarsus, covered by *lig. carpi dorsale*, and the tendons of the extensor muscles; is formed by *ram. transvers.* of *art. radialis* and *ulnaris*; gives off:

a. *Rami ascendentes*, which pass opposite to branches of *art. inteross. anter.*

b. *Rami descendentes*, the short roots, anastomosing with *artt. perforantt. arcus volaris profund.* of

Artt. interosseæ metacarpi dorsales. These are larger or smaller, going along to the inferior extremity of spaces between the metacarp. bones, or to the articulations of the first and second phalanx, pass with branches of *arcus volar. sublimis*, and assist in forming *art. digitales*.

2. *Arcus volaris profundus*, lies close upon the palmar surface of the *basis ossium metacarpi*, covered by the nerves, tendons, and muscles of the palm of the hand, below slightly convex; principally formed of the transversely passing terminations of *art. radialis*; gives off:

a. *Rami ascendentes*, very short branches for the *carpus*, which anastomosing with branches of *radialis* and *ulnaris* (and *interossea*) form the *rete carpeum volare*.

b. *Rami descendentes* s. *interosseæ volares*, three to four; they pass in the second to the fourth *spatium inteross. metacarpi*, at the inferior extremities of which they anastomose with the branches of *arcus volare sublimis*. The first and largest at the radial border of the index finger is often wanting.

c. *Rami perforantes*, three, pass at the superior extremities of the second to the fourth *spat. inteross. metacarpi*, from before backwards to the *rr. descend. art. radialis*, and form with these the small *interosseæ dorsales*. (See *arcus dorsalis*.)

3. *Arcus volaris sublimis*, lies in the palm of the hand, covered by *aponeurosis palmaris*, upon the tendons of *flexor. digitor.*, below convex; rather nearer to the carpal articulation than the deep arch; chiefly formed of *ram. sublimis art. ulnaris*. From the convexity arise:

Art. digitales, three, which pass between the tendons of the flexors of the fingers to the heads of the *ossa metacarpi*, in the second to the fourth interspaces, there anastomosing with the *interosseæ dorsales*; they bifurcate, and thus supply the radial border of the five fingers, and the ulnar border as far as the second finger. On the anterior surface of the phalanges, lying close to the flexor tendons, they send branches to the dorsal surface, which, like these, but smaller, pass to anastomose with each other by means of transverse branches, and give branches to the skin.

The radial border of the index finger and thumb is supplied by *ram. volaris art. radialis*, which anastomoses with the *arcus volaris sublimis*.

Aorta descendens, the descending aorta.

570. A. *Aorta descendens thoracica*, the thoracic aorta.

Position: on the left side of the twelfth [eighth inferior] dorsal vertebra, seven to eight inches long, before the vertebral column (above separated by *duct. thoracic.*); behind the left pulmonary vessels (above), the *œsophagus* (below), and the pericardium (in the centre); has to the left the *mediastinum*, to the right the *œso-*

phagus (above), *Ven. azygos* and *duct. thoracicus* close to it (above, where it winds to the left, behind it); is surrounded by much adipose tissue, and many lymphatic glands. Branches :

1. *Artt. bronchiales*, two to the left, one to the right; they arise sometimes from a common trunk, from the anterior wall of the *aorta* (also from *mammar. interna* or *subclavia*), and pass forwards to the posterior wall of the *bronchus*, ramifying on the *bronchia* and pulmonary vesicles; they give branches to the *œsophagus*; bronchial glands, and anastomose with the coronary arteries of the heart and *thyreoidea inferior*.

2. *Æsophagea*, five to seven, thin and long, arising in front from the *aorta*; they pass to the anterior surface of the *œsophagus*, in the mucous membrane of which they terminate, and send long branches upwards and downwards.

3. *Mediastinæ posticæ*, small branches for the posterior wall of the pericardium and the mediastina. Two *phrenicæ superiores* arise deeply, pass to the internal crura of the diaphragm, and anastomose with the *œsophageæ*.

4. *Intercostales posteriores*, eight to nine for the second, or third to eleventh intercostal space (the first and second are supplied by *intercostal. prima*. See *subclavia*). Origin: from the lateral walls of the *aorta*; the superior at an acute, the inferior at a right angle. Course: the superior upwards, the inferior more horizontally outwards, over the heads of the ribs into the intercostal space next above, and divided between the heads of the two ribs into *ram. anterior* and *posterior*. Situation: behind the *pleura* and the trunk of *sympathicus*; the right behind the *œsophagus*, *ductus thoracicus*; and *Ven. azygos* also; the left behind *v. hemiazygos* and *sympathicus*; the two last (right and left) covered by the crura of the diaphragm.

Branches: besides many small osseous branches for the bodies of the vertebræ, the following:

a. *Ramus anterior s. intercostalis*, passes in the direction of the trunk, in the centre of the intercostal spaces, at first between *pleura* and *m. intercost. intern.*, then between *intern.* and *extern.*, and there divides into:

1. *Ram. sup. s. infracostalis*, the continuation of the trunk which passes on the inferior border of the rib situated above, in a proper groove, as far as the anterior third, then in the middle of the intercostal space, descending and anastomosing with *a. mammar. intern.*, *epigastrica*, *phrenica*, *circumflexa ilei*.

2. *Ram. inferior. supracostalis*, which passes to the superior border of the rib lying below, and is lost in the periosteum and the muscles.

b. *Ramus posterior s. dorsalis*; passes between *process. transversi*, on the external border of *lig. colli costæ intern.* backwards, and divides into:

1. *Ram. spinalis*, which passes through *foram. intervertebrale*, with a branch for the body of the vertebra, with another for the *medulla spin.*

2. *Ram. muscularis*, a larger branch, which ramifies between *longissim. dorsi* and *ileocostalis*, and is lost in the skin.

571. B. *Aorta descendens abdominalis*, the abdominal aorta.

Situation: almost in the middle, yet rather to the left, before the first to the fourth abdominal [lumbar] vertebra; surrounded in the *hiatus aorticus*, close to *ductus thoracicus* and *Ven. azygos* by the crura of the diaphragm; in the cavity of the abdomen on the left side of *Ven. cava inferior*, covered by *gangl. celiacum*, the *corpus pancreatis*, and *pars horizontal. infer. duodeni*, the left emulgent vein, root of *mesenterium*, and lumbar portion of peritoneum (to the left below).

572. Anterior *azygos* branches (these are the arteries for the organs of digestion).

1. *Cœliaca*, the cœliac axis, half to one inch long, four lines diam. Origin: at a right angle from the anterior wall of the *Aorta*, while still in *hiatus aorticus*, close under *artt. phrenicæ inferr.* Position: behind the *curvatura minor* of the stomach, on the right side of the *Cardia*, between the layers of the small omentum, upon the superior border of the *Pancreas*, under the left lateral part of the *lobul. Spigelii*, closely surrounded with *plexus celiacus*. Branches pass off from a single point (*tripus Hallerî*), to Stomach, Liver, and Spleen (all lying above *mesocolon transvers.*)

1. *Coronaria ventriculi sinistra*, the smallest of the branches of the *cœliaca*. Course: to the left and above to the right side of the *cardia*, then again curves to the right, passes in the semicircle on the small curvature (between the layers of the small omentum), and anastomoses with *art. cor. vent. dextr. hepaticæ*. Branches: *artt. œsophageæ inferr.* to the inferior portion of the *œsophagus*; *artt. cardiacæ* surround the *cardia*, and supply the *fundus ventric.*; *artt. gastricæ* arise along the small curvature, and supply the anterior and posterior walls of the stomach; very frequently a *ram. hepaticus* (to the left lobe of the liver).
2. *Hepatica*. Course: transversely to the right, above the *pancreas*, to the right before the trunk of the *ven. portæ*, gives off *art. pancreatice mediæ*, and divides (one to two lines from origin) into a superior and inferior branch.

a. *Ram. hepaticus*, the superior branch, passes obliquely forwards to the *Porta*, where it divides into *art. hepat. dext.* and *sinistra*. Position: before *foram. Winslowi* in the *lig. hepatico-duoden.*, below the *ven. portæ*, to the left side of *duct. choledochus*.

1. *Pylorica s. coronaria dextra*, a small branch passes along the small curvature to the left, supplies the anterior and posterior surfaces of the stomach, and unites with *coron. ventric. sinistra*.
2. *Hepatica sinistra* passes through the left portion of the *Porta* to the left lobe of the liver, *lobul. quad.* and *Spigelii*. Branches pass transversely.
3. *Hepatica dextra*, thicker, passes, divided into several branches,

between the *rami* of the *ven. portæ* to the right lobe of the liver, gives off *art. cystica*, which, with a branch above and below the gall bladder, passes from neck to fundus.

- b. *Ram. gastro-duodenalis*, passes downwards between the commencement of *Duodenum* and the head of the *Pancreas*, and from *pylorus* along the great curvature between the layers of the great omentum.

Branches :

1. *Pancreatico-duodenalis*, passes downwards on the *pars descend. duodeni*, between it and *Pancreas*, gives off *artt. pancreatic. dextra* and *duodenales*, which anastomose with *jejunales* of *mesenter. superior*.

2. *Gastro-epiploica dextra*, is that portion of *ram. gastro-duodenal.* which passes along the great curvature, gives branches to the anterior and posterior surface of the Stomach, and six to eight *rr. epiploici*, which descend between the laminæ of the great omentum. Anastomoses at the *fundus ventriculi* with *coron. ventric. sinistra*.

3. *Lienalis*, the splenic artery—the largest branch of the *cæliac*—passes very tortuously along the superior border of the *Pancreas* (in a sulcus) to the left, and enters the spleen at the *hilus* divided into (four to ten small, or two principal) branches. Situation: behind the stomach.

Lateral branches :

- a. *Artt. pancreaticæ* (four to six), tolerably large, to the left portion of the *Pancreas*.

- b. *Art. gastro-epiploica sinistra* descends before the *cauda pancreat.*, behind the fundus of the stomach, passes to the left part of the great curvature, and gives ascending branches into the left part of the great omentum.

- c. *Art. breves* (two to six), arise from one or several terminal branches close to the Spleen, and pass backwards to the *fundus*, as high upwards as the *cardia* of the Stomach.

2. *Mesenterica s. mesaraica superior* (seven to eight inches long) supplies the small intestines and the right half of the large. Or.: close (one inch) below *cæliaca*. Course: between the laminæ of the mesentery in the root, as far downwards as the *right iliac fossa*, a little to the left and below curved; it is lost, becoming very small in the cæcal region.

Situation: at first behind *Pancreas*, between it and *Aorta*, then separated from this by the boundary between *duodenum* and *jejunum*, as it enters below the *Pancreas* into the root of the mesentery. Branches for *Pancreas*; for the small intestines from the left convex, for *colon* and *cæcum* from the right concave side.

1. *Artt. intestinales* (s. *jejunales et ileæ*), ten to fifteen larger (eight to twelve smaller) branches, which pass downwards and forwards for two to three inches in length, then divide and unite in loops or arches with one another. After a threefold division and junction, branches pass off

from the convexity of the last loops, which form a superficial vascular rete (under the peritoneal investment) and a deep upon the mucous membrane of (fifteen to twenty feet long) the small intestines. From one artery arises in the embryo (two to three months) the

Art. omphalo-mesaraica, which passes from the abdomen through the umbilical cord into the umbilical vesicle, and afterwards becomes imperious.

2. *Artt. colicæ* pass from the *mesenterium* into the *mesocolon*, divide in the neighbourhood of the large intestines, and unite in larger arches, from which anterior and posterior branches immediately come off; the superficial and deep ramusculi of which supply the parietes of the large intestine. There are:

- a. *Art. colica dextra superior*, passes downwards to *colon ascendens*, and anastomoses by means of an ascending branch with *a. colica media*, by a descending branch with *a. colica dext. inferior*.
- b. *Art. colica dextra inferior*, s. *ileo-colica*, arises deeper, about the centre of *mesenterica superior*; passes downwards, and gives an ascending branch to *colon ascendens* (which anastomoses with a.); a descending to *cæcum* (*art. cæcalis*) and *ileum* (which anastomoses with the termination of *mesenter sup.* itself); and *art. appendicilis* for the vermiform process of the *cæcum*.
- c. *Art. colica media*, arises above from *mesent. super.* passes forwards to the *colon transversum*, and anastomoses with *art. colica dextra*, and to the left with *art. colica sinistra*.

3. *Mesenterica inferior*, smaller than *art. mesent. super.*, supplies the left half of the large intestines. Or.: about two inches above the place of bifurcation of the *Aorta*. Course: at first downwards upon the *Aorta*; then before the *A. iliaca com. sinistra* downwards, and to the left in the *mesocolon descendens*; it divides two inches from the origin, into:

1. *Colica sinistra superior*, passes transversely outwards before the left *art. spermat.* and ureter, then behind the *colon sinistrum* and peritoneum upwards, divides into a superior and inferior arched branch, and supplies *colon sinistr.* as far as *flexura sigmoidea*.
2. *Colica sinistra inferior*, supplies the *flexur. sigmoidea*.
3. *Hæmorrhoidalis superior* s. *interna*, descends in the *meso-rectum* to the *rectum* and on its posterior wall to the *sphincter ani*, where it anastomoses with *hæmorrhoidalis media* (from *A. hypogastr.*) and the vesical artery.

573. The lateral branches of the Abdominal Aorta, given off in pairs.

4. *Phrenica inferior*, one on either side, arise close under *hiatus aorticus* (frequently from *a. cæliaca*, or from a common trunk), pass upwards and outwards, spread about the *hiatus aortic.*, *foram. quadrilat.*, and reaches with an external branch to the attachments of the diaphragm, where it anastomoses with *artt. intercostal.* and *mammaria int.*; it gives off

Artt. suprarenales superiores for the *caps. suprarenales*.

5. *Suprarenales mediæ* pass before the crura of the diaphragm transversely outwards (the right behind *ven. cava*), and spread out upon both surfaces of the suprarenal capsules.

6. *Renales*, short and thick, sometimes two to four (*emulgentes*). Or.: at a right angle close under *mesenterica super.*, frequently deeper. Course: transversely outwards and backwards to the *hilus* of the kidney. Position: surrounded by fat, behind the peritoneum and the *V. renalis*, before the body of the second lumbar vertebra, before the crura of the diaphragm and *Psoas major*. The right passes behind *V. cava. infer.*, and is also longer than the left, which arises higher. Branches:

a. *Artt. suprarenales infer.* for the suprarenal capsules and adipose tissue (*artt. adiposæ*).

b. Three to six terminal branches pass through the *hilus*, before the renal pelvis and behind the veins, and form, between the *cortical* and *tubular* substance, a rete which especially supplies the cortical substance.

7. *Spermatica interna*. Or.: at an acute angle from the anterior wall of the *aorta*, under *art. renalis* (rarely above, rarely from this). Course: descends on the inner side of *V. spermat.* backwards as far as the pelvis, behind the peritoneum, before *psaos* and *ureter*; the right obliquely before *V. cava*, the left before the sigmoid flexure of colon. Within the pelvis, internal to *psaos*, before *A. iliac. externa*.

In the male: it extends through the inguinal canal (together with *Vas deferens*; and *Vv. spermaticæ*) to the *testicle* and *epididymis*.

In the female: very tortuous, between the layers of the *lig. uteri latum* below the *ovaria*, it anastomoses with *art. uterina*, gives small branches to *lig. uteri latum* and the ovary.

8. *Lumbales* (three), five on either side. Origin: at a right angle from the posterior circumference of *aorta* before the lumbar vertebræ. Course: (like *artt. intercostales*) transversely outwards, behind the crura of the diaphragm (the superior), behind *m. psaos* (the inferior); on the basis *proc. transvers.*, dividing into:

a. *Ram. posterior*, passes with a *ram. spinalis* through *foram. intervertebrale*, partly to the bodies of the vertebræ, partly to the spinal marrow; with a *ram. dorsalis* to the muscles and skin of the lumbar region.

b. *Ram. anterior. s. abdominalis*, smaller, passes between *quadrat. lumbor.* and *transvers. abdom.* to the abdominal muscles; the branch of the first *art. lumbalis* along the lower border of the twelfth rib obliquely forwards; the branches of the fifth *art. lumbalis* along the *crista oss. ilei*, supplies the abdominal muscles, *iliacus* and *glutæi*.

574. At the inferior extremity of the Abdominal Aorta, the single.

9. *Sacra media*, small. Or.: close above or at the point of bifurcation from the posterior wall of the *aorta*. Course: vertically downwards, before the

fifth lumbar vertebra, the *sacrum coccyx*, behind the *rectum*. Branches: pass off laterally over the separate vertebræ to the bones and periosteum, and anastomose with *artt. sacra laterales*; on the *basis of coccyx* arched.

575. C. *Iliacæ communes*, the common Iliac arteries.

Origin: before the fourth lumbar vertebra these two principal trunks pass off from the anterior wall of *aorta abdominalis*, at an acute angle (in the male = 65° , in the female = 75°). Course: extending, downwards and outwards and rather backwards, about two inches long; between them a triangular space, the base of which is situated at the inferior border of the fifth lumbar vertebra. Position: behind the peritoneum and ureter (crossing with the last), on the inner side of *m. psoas*, on the left side of *Vv. iliacæ communes*; surrounded by lymphatic glands. The right passes over *V. iliac. commun. sinistra* to the inner side of *V. iliac. commun. dextra*. The left passes from the commencement on the left (external) side of the vein, and is in front covered by *Art. hæmorrhoidalis interna*. Branches: small to the *Vv. iliacæ communes* and lymphatic glands, otherwise none. Each *Art. iliac. commun.* divides rather above *Symphysis sacro-iliaca* into two terminal branches: *Art. hypogastrica* and *cruralis*.

576. I. *Hypogastrica* s. *Iliaca interna*, the internal Iliac artery, the internal branch of *iliaca commun.*, passes at first rather downwards and forwards, then slightly curved, before *symphysis sacro-iliaca* into the small pelvis, and divides, after a course of an inch to an inch and a half, either into two (an anterior and a posterior) or into eight (in the female ten) branches. Position: behind the peritoneum, on the left side the *Vv. hypogastr.*, *A. hypog. sinistra* passes over *V. iliaca com. sinistra*, inwards.

577. Anterior branches:

1. *Umbilicalis*, the umbilical artery of the embryo. *Vesicalis*, the vesical artery of adults.

The umbilical arteries, very large in the embryo, the blood of which they carry to the placenta, pass downwards, curved forwards and outwards, to the sides of the urinary bladder, upwards and inwards to the umbilical ring, from which they pass out into the umbilical cord and placenta, winding round the *Vena umbilicalis* spirally. After birth the portion between the naval and urinary bladder is closed, and forms the *lig. laterale vesicæ*. From which piece, still open and with thick walls (*art. vesicalis*) arise:

1. *Artt. vesicales*. a. *Posterior* on the posterior wall of the bladder from the base to the vertex. b. *Anterior* on the anterior surface, often arises from

art. uterina. c. Inferior, often from *Art. hypogastrica*; at the base of the bladder it also supplies the seminal vesicles.

2. *Art. uterina* arises frequently from the *hypogastric.*, passes transversely inwards, curves from the external border of *collum uteri* into *lig. latum*, at the sides of the *uterus* up to the *fundus*, supplying with several anastomosing branches the anterior and posterior surfaces of the uterus, and penetrating into its substance. All these are very tortuous, and particularly developed during pregnancy. Branches: *tubaria* passes with three long branches to the fimbriæ and Fallopian tubes, giving off the proper *ovarica*.
3. *Art. vaginalis* descends on the side of the *uterus*, supplies this with many branches, also with a branch for the neck of the bladder, and terminates in an arch between *vagina* and *rectum*.

4. *Art. deferentialis*, generally from *vesicalis inferior* to the *seminal vesicles* and *vas deferens*, and *art. (vesico) prostatica* to the *pars prostatica urethræ*.

5. *Art. hæmorrhoidalis media*, sometimes wanting, or arises from *art. hypogastr.* and *pudenda interna*; passes laterally on the anterior surface of the *rectum*.

2. *Obturatoria*. Origin: below the *umbilicalis* from the *hypogastr.*, often from *iliaca externa* (rarely from *a. cruralis*), and in common with *a. epigastrica*. Course: horizontally forwards, on the lateral wall of the entrance to the pelvis, as far as and through (the superior angle of the) *foram. ovale* out upon the thigh, where it divides into an external and internal branch. Position: close under *m. psoas*, above *nerv. obturator*, behind the peritoneum.

Lateral branches in the pelvis:

- a. *Ram. iliacus* passes forwards between *fossa* and *m. iliacus*; anastomoses with *circumflexa ilei*.
- b. *Ram. pubicus* arches behind the *symphy. pubis*.
- c. *Ram. ascendens* small, anastomoses with *epigastrica*.

Terminal branches outside the pelvis:

- d. *Ram. interior s. internus*, between *m. obturat. extern.* and *os pubis*, arched on the inner half of *foram. obturat.* downwards and backwards; it gives branches to *mm. adductores*; to the scrotum (in the female to *labia externa*); anastomoses with *art. circumflex. interna*.
- e. *Ram. posterior s. externus*, on the outer half of *foram. obtur.*, terminates between the neck of the femur and *m. quadratus*, by means of anastomoses with *art. ischiadica*; it gives *art. acetabuli* (to the fat in the depth of the *acetabulum*).

578. Posterior branches of the *hypogastrica*:

3. *Ileo-lumbalis s. iliaca anterior*. Origin: sometimes with *art. glutæa* from the posterior wall, next to the origin of *hypogastrica*. Course: backwards and behind *n. obturatorius*, external and superior to the upper border of the *Sacrum*; behind *m. psoas*; divides immediately into:

- a. *Ram. lumbalis*, which ascends along the bodies of the lumbar vertebræ

behind *m. psoas*, gives off a muscular branch for *m. psoas* and *quadratus lumborum*, and a spinal branch through *foram. intervert.*, between the last lumbar vertebræ and sacrum to the spinal cord.

b. *Ram. iliacus*; passes transversely outwards upon the *fossa iliaca*, with a superficial branch on the inner, with a deep on the outer surface of the *Iliacus*, and supplies the muscles of the *periosteum*.

4. *Sacra lateralis*; very frequently two on either side. Origin: frequently from *art. glutæa*. Course: inwards and downwards, on the anterior surface of the *Sacrum* (external to the *foram. sacralia anterr.*): anastomoses in front with *sacra media*, and gives branches to the posterior internal bony walls. Besides these: *rami spinales*, which enter through *foramen sacralia anterr.* into the *canalis spinalis* to the nerves, and through *forr. sacrr. posterr.* to the spinal muscles.

5. *Glutæa (superior) s. iliaca posterior*, the glutæal artery. The largest branch of the *hypogastrica* passes out from the pelvis, curving backwards and outwards: passes between the first sacral and fifth lumbar nerves to the highest part of *incisura ischiadica*, above the superior border of *m. pyriformis*, and immediately divides into a superficial branch, which ramifies under *glutæus maximus* on the posterior and superior part of it, and into a deeper branch, which passes between *m. glutæus med.* and *minimus* on the superior border forwards and upwards. *Nutritia Ilei* passes inside the pelvis at the inferior part of *os Ilei*.

579. Terminal branches of the *hypogastrica*:

6. *Ischiadica s. glutæa inferior*. Origin: often in common with *glutæa* or *pudenda interna*. Course: before the *glutæa*; passes out of the pelvis under *m. pyriformis*, and above *lig. sacro-spinosum* through *incisura ischiadica*. Position: on the inner side of *N. Ischiad.*, behind the *pudenda*. Branches: internal pass transversely between *m. glutæus max.* and *lig. tuberosa sacrum*, and to the skin of the *coccyx*; several descend with *N. Ischiad.*, others to the rotator muscles; anastomoses with *art. circumflexa ilii*, behind *collum femoris*.

7. *Pudenda (communis s. pudica interna)*. Course: passes out before the *plexus sacral.* downwards, between *m. pyriform.* (below it) and *lig. spinoso-sacrum* from the *incis. ischiad. major*, turns round the external surface of the *Spina*, and passes between *lig. sacro-spinos.* and *tuberosum* through *incis. ischiadic. minor* again within the pelvis; then ascends on the inner surface of *tuber Ischii*, the *rami* of the *ischia* and *pubis*, as high as the *symphysis pubis*; at that place lying close to the bones upon *m. trans. perinæi* and *ischio-cavernosus*. Branches: small for the urinary bladder, rectum, *vesiculæ seminales*, *Prostata* or *Vagina*; close to the *spina ischii* branches to the rotator muscles; on the *tuber Ischii* external muscular branches, and an anastomosis with *art. ischiad.* between *tuber Ischii* and *trochanter*; the internal are:

a. *Artt. hæmorrhoidales infer. s. externæ* for the *rectum*, *sphincter*, and *levator ani*.

Terminal branches: b. *Perinæa (superficialis)*. Or.: at the posterior border of *m. trans. perinæi*. Course: from behind forwards, and from without inwards on the inner side of *m. ischio-cavernos.*, and terminates in the centre of the *scrotum* as *art. septi scroti*. Position: above *fasc. perinæi superficialis*, below, *m. transvers. perinæi superf.* Branches: *transversa perinæi* passes behind transversely over the *perinæum*; *scrotales posteriores s. labiales*, at the termination of the *perinæum* to the posterior part of the *scrotum* or *labia*.

c. *Profunda perinæi s. art. penis (clitoridis)* is the name also given to that part of the *pudenda* from the posterior border of *m. transvers. perin.* as far as *symphys. pubis*. From it pass off:

a. *Bulbosa s. bulbi urethræ*, a large branch, transversely to the posterior boundary of *bulbus urethræ* (or to the Vagina [the *nymphæ*]), ramifying in *corp. cavernos. [spongiosum] urethræ* to the *glans*.

b. *Dorsalis penis (or clitoridis)* perforates between the roots of the *corp. cavernos.* and the *symphys. pub.*, the *ligam. suspensor.*, passes close beneath the skin very tortuously upon the back of the *penis* to the *glans*, behind which it forms a vascular circle, and supplies the foreskin and *glans*.

c. *Cavernosa s. profunda penis (or clitoridis)* passes in the middle of the cavernous body along the septum, and ramifies very delicately inside it, as far as the *glans*, anastomosing with the *bulbosa* and *dorsal. pen.*, and that of the other side through the septum. J. Müller's *Artt. helicinæ*, the tendril-like tortuous capillary vessels of *cavernosa*, which terminate blindly, and are said to give rise to the *erectio penis*, are probably artificial anatomical products. (Henle.)

580. II. *Cruralis*, the external Iliac artery,

the external branch of *Iliaca communis*, passes from the place of division of the last in the pelvis, as *Art. Iliaca externa*, on to the thigh, as: *femoralis*, as far as the popliteal space, where it is called *popliteæ*.

581. A. *Iliaca externa*.

Origin: before the superior border of *symphysis sacro-iliaca* from *art. iliaca communis*. Termination: at the femoral arch in the centre between *symphysis pubis* and *spina ilei super.* Length: three and a half inches. Course: extends obliquely from above downwards, from within outwards, and rather forwards, into the pelvis. Position: covered before and internally, loosely, by peritoneum; crossed by the *ureter*; separated from it on the inner side of the *m. psoas* by *fasc. iliaca*; before *ven. iliaca externa*. Before the right *art. iliaca* rests the termination of the small intestines; before the left the sigmoid flexure of

colon. Behind the *ligam. Poupartii*, it is situated on the outer side of the vein (in the same sheath with it), on the inner side of *nerv. cruralis*. Branches :

1. *Epigastrica (inferior s. interna)*. Origin : two to three lines (sometimes half an inch to two inches above *lig. Poupartii* from the inner side of *Iliaca externa*, or in common with *art. obturatoria*). Course : 1. at first transversely inwards to beneath the spermatic cord (or *lig. rotund.* of the female) ; 2. then bends upwards, concave above ; 3. lastly, directly upwards to the *umbilicus*. Position : 1. before *Ven. cruralis*, crossed by *vas deferens* which ascends vertically behind it, then above it anteriorly and in the inguinal canal ; half an inch to an inch and a half (at the convexity of the crossing points is the abnormal origin of *obturatoria*, which then winds round the upper and inner boundary of the femoral ring) ; 2. obliquely behind the posterior wall of inguinal canal, upwards and inwards, between *fasc. transversa* and *peritoneum*, it forms the boundary between *fovea inguinal. externa* and *interna* ; 3. at the outer border and the posterior surface (inside the sheath) of *m. rectus abdominis*. It is lost in the umbilical region, as it anastomoses with *A. mammar. intern.* by means of a capillary rete inside the *m. rectus*. Branches :

a. *Art. spermatica externa*, enters the inguinal canal, passes through it along the anterior surface of the spermatic cord (*lig. uteri rotundum*), and passes to the scrotum (*labia majora*) outwards ; anastomoses with *spermat. interna*.

b. *Art. pubica*, passes along the *crista oss. pubis* internally, where it anastomoses, behind the Symphysis, with the artery of the other side.

c. *Ram. obturatorius*, descends on the superior and internal border of the femoral ring behind the *ram. horizontal. oss. pubis* to *art. obturator.* ; is sometimes so large that the *art. obturatoria* appears to arise from *art. epigastrica*.

2. *Circumflexa ilii s. epigastrica externa*. Origin : opposite to the last, or below it, from the outer side of the *art. iliaca ext.* ; sometimes double. Course : obliquely outwards and upwards to the *spina ilei anterior superior*, hence arched along the *crista oss. ilei*, between *m. obliq. intern.* and *transvers. abdom.* to the *art. ileo-lumbalis* backwards. Position : at first behind *ligam. Poupartii* between the two laminae of *fasc. iliaca*, then only covered by the peritoneum. Branches : ascending for the abdominal muscles and skin ; descending for the *fossa iliaca*. In the region of the *Spina ilei*

Ram. abdominalis ascends, parallel with the *art. epigastrica*, between *m. transversus* and *obliquus internus*, and anastomoses with *artt. lumbales* and *intercost. inferr.*

582.

B. *Femoralis*, the femoral artery,

is that part of *art. cruralis* which reaches from the femoral ring to the inferior third of the thigh, passing downwards, inwards and a little backwards, in the direction of a line which commences in

the centre between *spina ilei anter. superior* and *symphysis pubis*, and terminates on the inner side of the limb, below its middle. Position: for about three inches below Poupart's ligament the artery is covered in front by the skin, *fasc. lata* and lymphatic glands, then by *m. sartorius*, which passes obliquely from above downwards and from without inwards, and inclines to the inner side of *vastus intern.* in the groove between this and the insertions of the *Adductores*. Behind it rests in a groove between *m. psoas* (without) and *pectineus* (within), upon the body of the *os pubis*, the *eminentia ileo-pectinea*, before the internal third of the acetabulum, so that a space of from one inch to one and a half is found between it and the superior part of the *os femor.*, farther down upon the *adductor magnus*, the tendon of which it perforates, and passes upon the posterior surface of the thigh. Above, the vein lies to the inner, farther down on the posterior side; the nerve on the outer side of the artery. The *art.* and *ven. femor.* lie in a proper sheath, into which *n. saphen. internus* penetrates, whilst *nerv. cruralis* remains in its own sheath. Branches:

1. *Inguinales*, three to six, small, arise in front close under *lig. Poupart.*; they ramify in the glands and skin of the groin.

2. *Epigastrica superficialis*, arises one inch below the femoral arch, in front, perforates *proc. falciform.*, passes vertically upwards, between the skin and *fasc. superficialis*, gives a transverse *ram. iliacus* inwards towards the *spina ilei*, and terminates at the *umbilicus*, in the skin.

3. *Pudendæ externæ* (*scrotales* or *labiales anteriores*), usually a superior and an inferior; they pass from *arcus cruralis* transversely inwards; the superior close under the skin to the *mons Veneris*, *penis* and *scrotum* (or *labia majora*); the inferior covered by the *fascia*, transversely before *Ven. crural.*, under *ven. saphena*.

4. *Profunda femoris*, supplies the muscles and skin on the inner and posterior surface of the thigh. Origin: $1\frac{1}{2}$ to 2 inches below the femoral arch, sometimes also higher, rarely deeper. Course: immediately backwards, then downwards between *mm. adductores*, closer to the bone than *art. femoralis*, perforates the *adductor magn.* (above the perforation for *femoralis*), and is lost in *biceps* and *semitendinosus*. Position: above before the termination of *flexor. femoris* and *pectineus*, lastly *adductor magnus* and *brevis*, behind *adductor longus*.

Branches: 1. The circumflex arteries, two.

2. The perforating arteries, three to five.

1. *Circumflexa femoris interna*, arises $\frac{1}{4}$ to 1 inch below the commencement of *prof. femor.*; passes backwards and transversely inwards between *m. pectineus* and *flexor. femor.*, above *trochanter minor*, to the

internal and posterior surface of the neck of the *femur*. Branches: *ram. superficial.* to *m. pectineus*, *abduct. long.* and *brevis*.

Art. acetabuli to the capsule and *lig. teres* of the *acetabulum*.

Ram. anastomotici to the superior part of the scrotum, uniting with the *obturatoria* and *pudenda*.

Ram. trochantericus, between *m. obturat. ext.* and *quadrat. femor.*, to the fossa of *trochanter major*, anastomosing with *glutæa* and *ischiadica*.

2. *Circumflexa femoris externa*, passes behind *m. rectus femor.*, before *Psoas-iliacus* outwards around the basis of *trochanter major*, and there ramifies, since it anastomoses with the *interna*, sends a branch upwards for *glutæus minim.* and *fascia lata*, another on the outer border of *rect. femoris* downwards almost as far as the *patella*.

3. *Perforantes*, three to five; they perforate the *mm. adductores* at their insertions, and then pass to the posterior surface transversely round the femur, and supply the muscles on the posterior surface of the limb. *Art. perfor. prima* perforates the *adductor magnus* below the *trochanter minor*, gives a branch to *n. ischiadicus* and a *nutritia femoris superior*; *nutritia magna* comes from the second or third *art. perforans*, [and takes a direction upwards]. They anastomose with the inferior branches of *femoralis* (also keep up the collateral circulation after ligature of the *poplitea*). The first also anastomoses with the *circumflex. femor.* and *glutæa*; the third is the terminal branch of *profunda femoris*.

583. C. *Poplitea*, the popliteal artery,

the continuation of *art. femoralis*, reaches, from the inferior third or fourth of the thigh, as far as to the superior fifth or sixth of the leg, and is about seven inches long. Course: somewhat oblique, from above, downwards, and from within, outwards to the centre of the popliteal region, hence, vertically downwards. Position: deep, (especially below) in the neighbourhood of the bone, it is covered behind—from above to below by: *m. semi-membranos.*, fat and *fascia poplitea*; *m. gastrocnemius* and *plantaris long.*, lastly *m. soleus*; close behind it, and externally (almost together) *Ven. poplitea*, and behind this *N. tibialis*. Before it lie—from above downwards—the inner and posterior surface of the *os femoris*, the knee-joint and *m. popliteus*. On the inner side: *m. semi-membran.*, *condyl. intern. femor.*, *caput intern. gastrocnemii*. On the outer side: *m. biceps*, *cap. extern. gastrocn.*, *plantar. long.*, *soleus*. Branches; posterior:

1. *Surales* s. *gemellæ*, two to four, arise at the knee-joint, pass forwards and downwards on the anterior internal surface of *m. gastrocnemius*; a branch with *n. saphenus* as far as *tendo Achillis*. Anterior branches:

2. *Articulares genu superiores*, superior articular arteries.

a. *Articularis interna I.*, s. *superficialis* [*s. anastomotica magna*] arises from *art. cruralis* whilst in the sheath of *m. adduct. magn.*, sometimes higher; the largest passes under *sartorius* to the *condylus internus*; a branch to the *triceps*, another with *n. saphenus intern.*

b. *Articularis interna II.*, passes transversely to the *condylus internus*, ramifies there and gives branches to the border of the patella.

c. *Articularis externa* arises opposite b, and passes transversely outwards to *condyl. externus*, and gives an :

Art.—superior media for the posterior surface of the knee-joint.

3. *Articulares genu inferiores*, inferior articular arteries.

d. *Articularis externa*, passes outwards and forwards above the fibula, covered by *gastrocn. extern.*, *plantar. long.*, *biceps*, and *lig. genu extern.*

e. *Articularis interna*, also passes inwards to the *condyl. tibie*. From it, if not from the *art. poplit.* itself, arises :

Art.—inferior media, which penetrates from behind through the middle of the capsular ligament into the knee-joint.

f. *Articularis infima externa*, passes transversely over the fibula outwards, covered by *m. peronæus long.* and *extens. digit. commun.*, ramifying in these as far as the fibula and knee-joint.

Rete articulare genu, is found on the anterior and lateral surfaces of the knee-joint, and behind *lig. patellæ*. It is formed by *artt. articulares genu*, connected above with the *perforantes profundæ femor.*, below with the *recurrentes tibie*.

584. III. *Tibialis antica*, the anterior tibial artery,

the anterior branch of *art. poplitea* (two or three inches below the knee-joint), passes, from the point of division of the last at the inferior border of *m. popliteus*, immediately forwards above the superior border of *lig. interosseum* (between the superior extremity of *tibia* and *fibula*). It then extends directly downwards before *lig. inteross.* as far as the inferior fourth of the *tibia*, thence inclines inwards and downwards to the dorsum of the foot, from which point it is called *art. pedis*. Position : very deep, before *lig. interosseum*, and farther down before the external surface of the *tibia*, behind and between *m. tibialis anticus* and *extensores digit. (commun. and halluc. long.)*; on the inner side of the *n. tibial. anticus*. At the tarsal joint: upon this, covered by *lig. cruciat.* and the tendons of *extens. halluc. longus*.—Branches :

1. *Recurrans tibialis posterior*, passes off close at the commencement of *tibialis*, upon the posterior surface of the tibia upwards to the joint; covered by *m. popliteus*.

2. *Recurrans tibialis anterior*.—Or. : close above *lig. inteross.* Course : inwards and upwards between *m. tibial. anticus* and *condylus extern. tibie*, close to the bone. Branches to *m. tibial. antic.*, *extens. digit. comm.*, *capitul. fibul.*; anastomoses with *articul. genu extern.*

3. *Art. malleolaris externa*, arises higher or deeper, above *lig. tarsi dorsale*. Course : curves outwards and forwards around the external malleolus to the outer surface of *os cuboideum*, and anastomoses with *art. tarsea externa* and *peronæa*.

4. *Art. malleolaris interna*, passes transversely under *tendo m. tibial. antici* inwards and above the *internal malleolus* to the internal surface of the *tarsus*, and anastomoses with *art. plantaris interna*.

585. *Pedica s. dorsalis pedis*, the dorsal artery of the foot, the continuation of *tibial. antica*, when it has passed out from under the *lig. tarsi dorsale*, passes upon the back of the foot, from behind forwards, as far as the posterior extremities of the *os metatarsi I. and II.*, and sinks between these to the sole of the foot. Position: on the external border along the tendons of *extensor halluc. longus*, on the internal of *extens. digit. brevis*, covered by the fascia and skin, only. Branches:

5. *Tarsea externa*. Origin: before the *collum astragali*. Course: obliquely outwards, under *m. extens. digitorum brevis*, to the basis of the fifth *os metatarsi*; anastomoses with *art. plantaris* under the sole of the foot.

Branches: 1. *Ram. posterior*, anastom. with *art. malleolar. externa* and *peronæa*.

2. *Ram. anterior*, passes forwards in a curve, anastomoses with *art. metatarsæa*, and sometimes gives the *interossea dorsalis* 3.

6. *Tarsea interna*, passes obliquely forwards and inwards, to the articulation of *os cuneiforme I.* and *metatarsi I.*, gives branches to the great toe before, and to the metatarsus behind.

7. *Art. metatarsæa*, arises, generally, in the interspace between first and second *os metatarsi* at the posterior extremity; passes transversely outwards, and forms the *arcus dorsalis metatarsi*, which anastomoses with *tarsea externa* and gives off anteriorly the *artt. interossea*.

8. *Art. interossea dorsalis I.* passes off from the *art. pedica*, before this betakes itself to the sole of the foot, into first *interstit. inteross.*, and supplies the dorsal surface of the outer and inner border of the great toe and the internal border of the second toe; it belongs therefore to the *arcus dorsalis*.

586. IV. *Tibialis postica*, the posterior tibial artery,

the posterior branch of *art. poplitea*, passes downwards in the direction of the last, at an acute angle from *art. tibialis antica* to the posterior surface of the leg and the internal malleolus; beneath this to the groove on the inner surface of *calcaneus*, and divides at the boundary between the sole and the internal border of the *metatarsus*, into *art. plantaris interna* and *externa*. Position: as far as the inferior third of the *tibia* before *m. soleus*, then on the inner border of *tendo Achillis*, covered by the fascia and skin, only; behind *m. tibialis posticus* and *flexor. digitor. longus*; on the inner side of *n. tibialis*. On the inner side of the *os calcis* covered by *lig. laciniat. internum* above, *flex. digit. long.* (within) and *hallucis* (without) it divides, close behind *caro quadrata*. Branches:

1. *Nutritiæ tibiæ*, large, passes downwards on the posterior and outer side of *tibia* as far as *foram. nutrit.*, and supplies the medullary cells.

2. *Art. peronæa s. fibularis*. Origin: at an acute angle, one inch to an inch and a half below the origin, on the outer wall of *tibial. postica*. Course: downwards along the inner posterior surface of the fibula, separated from it by *flexor halluc. long.*, and behind the external malleolus, on the outer side of *calcaneus*. Position: covered behind by *m. soleus* upon *tibialis posticus*, then between this and *flex. halluc. longus*, upon *lig. interosseum*. Behind *malleolus externus*; on the external border of *tendo Achillis* covered by *fascia* and skin, only.

a. Muscular branches backwards for *m. soleus*, externally for *mm. peronæi* and a *nutritia fibulæ* [directed downwards].

b. *Peronæa anterior s. perforans*, a thinner branch, passes down on the inferior third of the tibia through the *lig. interosseum* on its anterior surface, and passes into the *rete malleol. externum*.

c. *Peronæa posterior*, a continuation of *art. peronæa*, passes along the outer border of the *tendo Achillis*, covered by *fascia* and skin, only, to the outer surface of *calcaneus*, and anastomoses with *art. malleolar.* and *plantar. externn.*, and gives a transverse uniting branch which passes between the *tendo Achillis* and the bones to the *tibialis postica*.

3. *Malleolaris interna posterior* arises behind the inferior extremity of *tibia*, passes close to the bone from the tendons of *tibialis posticus* and *flex. digit. long.* to the inner malleolus and into *rete malleolare internum*.

4. *Plantaris interna*, the smaller internal terminal branch of *art. tibialis postica*. Course: along the inner border of the sole of the foot (one inch removed from it) forwards. Position: between *abductor hallucis* (within) and *flexores digitor.* (without), covered by the *fascia plantar.*

Branches: ascending to the articulations of the metatarsal bones. Terminal branches from the posterior extremity of *os metatarsi hallucis*:

a. *Ram. internus*, passes along the inner border of the *m. abductor hallucis* superficially.

b. *Ram. internus*, anastomoses with the trunk of *art. inteross. plantar. I.*

A branch passes through *fasc. plantaris* to the skin of the inner side.

5. *Plantaris externa*, the deeper external terminal branch of *tibial. postica*. Course: from the inner side of *calcaneus*, obliquely outwards and forwards as far as the posterior extremity of *os metatarsi V.*; an inch distant from the outer border of the foot; then curved inwards above *oss. metatarsi 4* to *2*, where it anastomoses with *art. pedicæ* (see *arcus plantaris*). Position: upon the tendons of *flex. digit. commun.* and *halluc.*, *caro quadrata*, *flex. digit. 5. brev.* and *interossei*; covered behind by *lig. laciniat.*, then by *abduct. halluc.*, *flexor digit. brevis*, *aponeurosis plantar.* (below).

Branches: to the *calcis*, to *mm. flexor. digit. brev.* and *caro quadr.*, to the Tarsus. *Art. plantaris digiti V. externa* passes under *flex. brevis digit. V.*, terminates at the outer border of the plantar surface of the little toe, and anastomoses with *art. dorsales tarsi* (compare *Arcus plantaris* and *Art. tarsea externa*.)

587. The vascular arches of the foot.

1. *Arcus dorsalis pedis* s. *tarsus dorsalis*, close upon the dorsal surface of the metatarsal bone, is before convex, and arises from the junction of the

Art. metatarsea with the anterior branch of the *art. tarsea*.

From it three branches arise :

Artt. interosseæ dorsalis pass in the second to the fourth *interstitium interosseum metatarsi*, where they give off the three :

Artt. perforantes, which sink downwards, and pass opposite to the *artt. perforantes* from the *arcus plantaris*;

whilst they divide in a forked manner at the anterior extremity into the small :

Artt. digitales dorsales, which betake themselves to the dorsal surface of the toes, from the external border of the second as far as the internal of the fifth toe, terminate on the first phalanx, and unite with the corresponding of *arcus plantaris*.

Both borders of the first and the internal border of the second toe are supplied from *art. dorsalis hallucis*, the terminal branch of *art. pedis*.

2. *Arcus plantaris (profundus)*, there is no *arcus plant. sublimis* present), close under the posterior extremities of the metatarsal bones in the sole of the foot, is convex before, and arises principally from the junction of :

Art. plantaris externa with *art. pedis* (also *tibial. postica* and *antica*).

From it three superior and five anterior branches arise :

a. *Artt. perforantes* (three) ascend (see *arc. dorsalis*).

b. *Artt. interosseæ*, four, pass in the second to the fourth *interstit. inteross.*, divide at the anterior extremity into two branches :

Artt. digitales plantares, which supply the outer border of the great, the inner of the fifth toe, and both plantar borders of the second, third, and fourth toes, and unite in an arch on the ungual phalanx.

588. The Veins of the great Circulation.

They form, with the exception of the two veins of the heart, two principal trunks, namely, *V. cava superior*, which carries the blood from the superior, and *V. cava inferior*, which carries it from the inferior half of the body to the right auricle of the heart. Both stand in relation by means of a lateral branch, *V. azygos*, which arises in the inferior half of the body and opens into the superior *vena cava*. With the system of the inferior cava an important one is included, the system of the Portal vein, and in the foetus the umbilical vein, besides.

589. A. *Venæ cordis* s. *cardiacæ*.

1. *V. coronaria magna cordis*. Course : from the apex of the heart as far as

basis ventriculi upwards in the anterior longitudinal groove; then leaves its *art. coron. sinistra*, turns in the left transverse groove at a right angle to the left, and opens at the posterior inferior surface into the right auricle, close to the *septum atriorum*, covered by *valvul. Thebesii*. Branches: from the walls of the ventricles and the *septum*; it receives besides:

- a. *V. cordis media* s. *Galenii* s. *posterior*, passes in the posterior longitudinal sulcus from the apex as far as the transverse, and opens in a wide place shortly before the orifice of *V. magna*.
 - b. *V. coronaria dextra*, passes from the left border of the heart in the transverse groove to the right, and opens shortly before the orifice of *V. magna*.
2. *Vv. minores cordis*, 3 to 4 small veins on the anterior surface of the right ventricle of the heart, open into the right auricle; below it frequently *v. coronaria dextra*. *Vv.* and *foramina Thebesii* do not exist farther.

590. B. *Cava superior* s. *descendens*, the superior or descending cava,

corresponds to the *arcus aortæ* and the *aorta thoracica*; arises in consequence of the association of *anonyma dextra* and *sinistra*—close behind the cartilage of the second right rib, one inch from the middle line of the body. Course: downwards on the right side of the sternum, from before to behind and from left to right to the superior part of the right auricle. Position: the superior portion; on the inner side of the right lung (the right anterior mediastina) and the *N. phrenicus dexter*; it lies to the left on the *art. anonyma* and *arcus aortæ*, behind *gland. thymus*, before (lymphatic glands and) *trachea*. The inferior portion inside the pericardium (one to one inch and a half long), close before: *bronchus*, *Art.* and *Ven. pulmonalis (super.) dextr.*; touches on the left *aorta ascendens*, is free to the right. *V. cava sup.* possesses no valves, and therefore pulsates. Length: three inches. Breadth, at the mouth, two inches. Sometimes two *Vv. cc. supp.* are present. Branches: *V. anonyma dextra*, *sinistra* and *V. azygos*.

591. 1. *Venæ anonymæ dextra et sinistra* [s. *Brachiocephalica*].

They correspond on the one side to *truncus anonymus*, on the other to *carotis* and *art. subclavia*. Origin: behind the *articulatio sterno-clavicularis* and from the junction of the *Ven. jugularis interna* and *subclavia*. Without valves.

Anonyma dextra.

Length: twelve to fourteen lines. Course: vertically downwards and inwards. Pos.: parallel with *art. anonyma*, which is close to it on the left; one inch from the middle line; to the right and behind *N. phrenicus* and *art. mammar. dextra*. Branches: *Vv. mammaria interna* and *thyreoid. infer. dextra*; often the *v. vertebralis* alone.

Anonyma sinistra.

Longer (two inches) and thicker. Course: almost horizontal, backwards concave. Pos.: above *arcus aortæ*, behind the superior border of the Sternum, before *art. anon.*, *carot.*, and *subclavia sinistra*. Branches: *Vv. mammar. interna*, *thyreoida sinistra*, and *phrenica super.*, *thymica*, *pericardiaca*, and often *v. intercostalis superior* and *v. vertebralis*.

The collateral branches :

1. *Vv. thyreoidæ inferiores*, one *dextra*, one *sinistra*. Course: like *art. thyr. infima*; the former opens in the angle between the two *Vv. anonymæ*, the latter into the left *v. anonyma*; they receive *Vv. tracheales* and *laryng. (plexus trachealis)*.
2. *Vv. mammaria interna*, two for each artery; they receive *Vv. sternales (plexus sternalis)*.
3. *Vv. phrenicæ*, very long and small; they pass with *N. phrenic.* and *art. phren. super.*
4. *V. vertebralis*. Origin: in the deep cervical muscles, and a smaller branch from the *foram. condyloid*. Course: in the *canal. vertebralis*, passes out under the sixth or seventh vertebra, and opens close behind *V. jugul. intern.*; receives *V. cervical. ascend.* and *profund.* Position: behind *art. subclavia*.

592. 1. *Jugularis interna*, the internal jugular vein, corresponds to the *carotis communis* and *externa*. Or.: in the *foram. jugulare* with a sacciform enlargement, *bulbus*, passing out of the *sinus transversus* of the cranial cavity. Course: descends at first behind, then on the outer side of *carotis interna, communis*, and *N. vagus* (which lies in a sheath between the artery and vein behind them), and terminates, with an oval enlargement, *bulbus*, at the origin of *truncus anonymus* before *Art. subclavia*. From *foram. jugular.* to the superior border of the larynx, called *cephalica interna*, two inches and a half to three inches long; it is covered by *m. digastricus* and *sterno-mastoid*, on the outer side of the *nn. glossophar., hypogloss.,* and *pharynx*, on the inner of the *proc. styloid.*, before *proc. transvers.* of the first to the third vertebra. At the larynx it receives the short *cephalica externa*, which arises from the junction of *facialis anterior* and *posterior*.

- a. *V. facialis anterior* corresponds to *art. maxillar. externa*. Course: external and behind *art. maxillar. extern.*, downwards and outwards from the internal angle of the eye, to the anterior border of *m. masseter* over

the lower jaw to one inch beneath its angle. Position: at the angle of the eye, as *ven. angularis*, before the *lig. palpebr. intern.*; then between *levat. labii alæq. nasi* and *orbicul. palpebr.*; upon *levator labii super.* and *buccinat.*, under the *zygomatichi*; beneath the lower jaw upon *gland. sub-maxillaris*. Branches:

1. *V. frontalis*, between the skin and *m. frontalis*, near the central line of the forehead, to the root of the nose.
 2. *V. supraorbitalis*, between *m. corrugator* and *frontalis*, from without inwards, anastomoses with *vv. temporales*; with *v. frontalis* over *lig. palpebr. intern.*; receives *v. diploica frontalis*.
 3. *V. ophthalmica*, passes backwards from the *v. angularis* between *lig. palpebr. int.* and *trochlea*, on the inner wall of the Orbita, then over *N. opticus*, leaves the *art. ophthalm.*, and passes, at the internal boundary of *fissur. orbit. super.*, into the *sinus cavernosus*. It receives: *v. sacci lacrymal.*, *ethmoidal. anter.* and *poster.*, *ciliar. long.* and *vorticosa*, *lacrymalis*, *central. retina*; lastly:

v. ophthalmica inferior, which lies on the floor of the orbit, formed of *vv. musculares* and *ciliares inferior.*, likewise anastomosing through *fissura orbit. infer.* with *ram. profund. v. facialis. anter.*
 4. *Vv. nasales*, from the back (dorsales) and *alæ* of the nose (*pinnales s. alares*.)
 5. *Vv. palpebrales inferiores* and *labiales superiores*.
 6. *Ramus profundus s. facialis profunda* unites the *v. facialis* with *v. maxillar. interna* and *ophthalmica*; arises from a *plexus* which is formed by *v. ophthalm. infer.*, *nasalis poster.*, *dentalis superior*, upon the posterior surface of the upper jaw, is connected with *plex. pterygoid.*, and opens below the *proc. zygomatic.* of the upper jaw.
 7. *Vv. labiales inferiores*, *buccales*, *massetericæ*, *submentalis*, *sub-maxillares*.
 8. *V. palatina* arises in the soft palate and from *plex. tonsillaris*; also open into *cephalica interna*.
- b. *Vena facialis posterior*. Origin: inside the *parotis* behind *collum condyli maxill. infer.*, from *v. temporalis* and *maxillaris interna*. Position: on the inner side of *carotis externa*. Course: behind the ramus of the lower jaw: united at an angle with *V. facialis anter.* It frequently opens, as it passes away before *sterno-mastoideus* into *V. jugularis externa*, and sends a large uniting branch, over *m. digastricus*, to *V. jugularis interna*. Branches:
1. *V. temporalis communis* passes backwards from *art. temporalis*, between the *meatus auditor. externus* and the maxillary articulation under the skin, and enters the *parotis*; unites behind *collum condyli*, with *V. maxillaris interna*; consists of:
 - a. *Temporales superficiales*; these are branches which pass from a rete with wide meshes from the forehead, vertex and occiput

between the skin and muscular layer, unite above the *proc. zygomat.* of the temporal bone, and unite before the external auditory meatus with:

- b. *V. temporalis media*; passes under *fascia media*; over *m. temporalis* from before backwards, perforates the fascia; consists of: *vv. palpebral.* and *orbitales externæ.*
2. *Maxillaris interna* corresponds to the inferior portion of *art. maxillar. intern.*; receives two *vv. meningeæ mediæ, v. dentalis inferior, vv. temporal., profundæ, pterygoideæ, massetericæ*; they form *plexus pterygoideus* in the inferior part of the temporal fossa, between *m. temporal.* and *pterygoid. extern.* and the two *pterygoidei.*
3. *Vv. parotidæ, auriculares poster. and anter., transversa faciei* form between *Parotis, m. masseter,* and about the maxillary articulation, the large *plexus massetericus*, which is connected above the *incisura semilunar.* with *pl. pterygoid.*
- c. *V. occipitalis* passes under *m. splenius* forwards, and receives several *vv. mastoideæ*, which pass out of *sinus transvers.* of the cranial cavity, and they establish an important communication between the external and internal cranial veins.
- d. *Ven. thyreoidea superior*; its branches come from the superior part of the thyroid gland, from below the *pharynx*, from the interior of the *larynx*; it opens into the short trunk of *cephalica externa*; likewise the *laryngea* and *lingualis* (*s. jugular. externa*).
- e. *V. thyreoidea media* arises from *art. thy. infer.*, opens into the trunk of *jugular. interna.*

593. *Jugularis externa* consists of an anterior and posterior (cutaneous) trunk, which open together behind the clavicle, and enter into the *V. subclavia* or *V. anonyma*. They have (two) valves.

1. *Jugularis externa anterior*, formed by one or two *vv. subcutaneæ* above the hyoid bone, descends along the inner border of *m. sterno-cleido-mastoideus*, and curves backwards behind the inferior termination of the muscle to the posterior trunk. A transverse branch unites the right and left vein, and generally receives the *V. thyreoid. media*; a superior transverse branch unites both in the region of the *os hyoides*.
2. *Jugularis externa posterior*. Origin: behind the angle of the lower jaw, from a branch of *V. facialis posterior, V. occipitalis,* and *auricular. superfic.* Course: oblique from above downwards, and from before backwards, over the *sterno-cleido-mast.*; from the angle of the lower jaw as far as the centre of the clavicle, then forwards and inwards to the *v. subclavia*. Position: superficial, covered by *M. platysmam.* and skin only; above, behind it *N. auricularis*; below, behind *m. sterno-cleido-mast.* Branches; besides the principal rami:

a superior connecting branch through the *Parotis* with *V. jugularis interna*;

an inferior, under the clavicle, to *V. cephalica* of the upper arm; farther:

Vv. transversæ colli and *scapulæ*; from *laryngea superior*, and often; *V. lingualis*. The superficial veins upon the *dorsum lingue* (*vv. linguales*) open between *m. lingualis* and mucous membrane in a *plexus lingual. superior* at the basis of the tongue. From it a branch accompanying the *n. lingualis* passes to

Vv. raninæ. They pass superficially beneath the tongue to the side of the *frenulum*, accompany *N. hypoglossus* between *m. genio* and *hyo-glossus*, are connected with *plexus inferior* at the side of the tongue, and open in the *Ven. lingualis*, which takes the same course as the artery (and, frequently, opens into *cephalica externa*).

594. 3. *Vena subclavia*, shorter than the *art. subclavia*. Origin: at the superior border of *m. serratus anticus*, from *v. axillaris*. Termination behind *artic. sterno-clavic*. Course: transversely inwards to the orifice of *V. jugularis interna* (in the *anonyma*), whilst *art. subclav.* is curved, or arches over the apex of the lung. Pos.: behind *m. subclavius* and clavicle, attached by *fascia cervicalis*; before *art. subclavia* (and *m. scalenus anticus*;) close above the first rib, beneath *fascia cervicalis* and the skin. Valves are wanting.

Branches: *V. intercostalis prima dextra*, generally *V. jugularis externa*; *transversa colli* and *scapulæ*. *V. subclavia* is a continuation of:

1. *Vena axillaris*, which is placed on the inner and anterior side of *atr. axillaris*, and consists of the *two venæ brachiales* united together, which pass deeply on both sides of *art. brachialis*. Branches: *circumflex. humeri*, *subscapul.*, *thorac. extern.*; they receive the *V. cephalica*, whilst the rest of the cutaneous veins open into *vv. brachiales*. The deep veins of the hand and the fore-arm correspond exactly with the distribution of the arteries of the same name, but are double, and anastomose together.
2. Cutaneous veins of the arm; they are larger than the muscular and deeply-seated veins, form plexus, and are situated between the muscular layers and the subcutaneous uniting tissue. Strongest on the dorsal surface of the hand, formed by the ascending digital veins, the plexus, concave above, sends off several branches upon the carpus, the most external of which, *v. cephalica pollicis*, passes on the thumb; the most internal, *v. salvetella*, on *os metacarpi V*. On the arm the cutaneous veins are more numerous on the flexor surface. They are:

- a. *Vena cephalica* s. *cutanea radialis*, the continuation of *cephalica pollicis*, passes along the outer surface of *radius* to the middle of it, about the external border upon the anterior surface, and divides, one to two inches below the bend of the arm, into the *mediana* and *cephalica brachii*. The last passes at first on the outer border of the *m. biceps*, then inwards to the groove between *m. pectoralis maj.* and *deltoid.*, where it opens (one inch below the clavicle) into the *vena*

axillaris ; it receives the cutaneous veins of the upper arm, shoulder, and breast.

- b. *Vena basilica* s. *cutanea ulnaris*, a continuation of *salvatella*, passes on the ulnar border and the flexor surface of the fore-arm, and unites with the *v. mediana* (one inch to two inches and a half) above the bend of the arm. When an *ulnaris posterior* is present, it opens higher up. In the upper arm it passes on the inner border of *m. biceps*, perforates the *fascia brachii*, and opens into *v. brachialis interna* or *axillaris*. It carries the blood of the volar side of the hand and of the fore-arm.
- c. *Vena mediana* passes obliquely from without inwards, and from below upwards, from *v. cephalica* to *v. basilica*, larger than either, lying in the bend of the arm over the *aponeurosis of tendo m. bicipit.* and *art. brachialis*. It carries the blood of the dorsal side of the hand and fore-arm, and also receives branches from the volar surface and the deep veins of the fore-arm. Varieties in these veins are particularly frequent.

595.

II. *Vena azygos*.

This vein corresponds with the *aorta thoracica*, uniting *v. cava inferior* and *superior* with one another. Or.: in the abdominal cavity ; before the first lumbar vertebra, rarely, from the *v. renalis* or *v. cava inferior* itself. Course ; through *hiatus aorticus* into the thorax ; on the right side of the thoracic vertebra as high as the third intercostal space ; curving over *bronchus* and *v. pulmonal. dextra* forwards, it opens at the posterior part of *v. cava superior* at its entrance into the *pericardium*. Situation : in the *cavum mediastin. posticum*, before the *vv. intercostales dextræ*, to the right of *aorta* and *ductus thoracicus*. It receives in front : *v. bronchialis dextra*, some *vv. œsophageæ*, and *mediastinæ* ; to the right the eight last *vv. intercostales dextræ* ; to the left *v. hemiazygos* and the *intercostales superiores sinistræ*.

1. *Vena lumbalis ascendens*, the connecting ramus of the transverse *vv. lumbales*, ascends, curved or in a straight line ; receives a branch from *ven. iliaca communis*, and passes into the *v. azygos* upon the right, into *v. hemiazygos* upon the left side.
2. *Vena hemiazygos*. Origin : from the four last *vv. intercostales sinistræ* and *v. renalis*. Course : through *hiatus aorticus*, along the left side of the vertebral column as high up as the eighth or seventh dorsal vertebra, passing before them, behind *ductus thoracicus* and *aorta*, into the *ven. azygos*. The superior (the second and third) *vv. intercostales sinistræ* generally form a trunk (*hemiazygos superior*), which opens from above downwards into *hemiazygos* or *azygos*, accordingly as it has received the

superior *ven. bronchial. sinistra*. It receives *vv. œsophageæ, mediastin.* and *pericardiaceæ*.

596. C. The *cava inferior s. ascendens*.

Origin : before the cartilage between the fourth and fifth lumbar vertebra, behind and to the right of the bifurcation of *aorta abdominalis*, by the junction of the two *vv. iliacæ*. Course : vertical from the fourth lumbar to the ninth dorsal vertebra ; on the inferior surface of the liver curved rather forwards and to the right towards the posterior portion of the right longitudinal fossa, it passes behind this through *foram. quadrilaterum* of the diaphragm, immediately (half an inch to three quarters of an inch) into the pericardium, and there horizontally forwards and to the left into the inferior posterior part of *atrium dextrum*.

Situation : to the right on the anterior surface of the bodies of the vertebra, to the right of the *aorta*, behind the *peritonæum*, the inferior horizontal portion of the *duodenum*, the *pancreas* ; before *m. psoas* and the right crus of the diaphragm ; above in a semi-canal of the liver. Without valves, except *valv. Eustachii* at its mouth. Collateral branches correspond to the distribution of the branches of *aorta abdominalis*, with the exception of *art. cœliaca* and *mesentericæ* (see the portal vein) ; they are :

1. *Vv. lumbales* and *lumbalis ascendens*.
2. *Vv. spermaticæ*. a. *Testiculares et epididymæ*, anastomosing with the *vv. pudendæ* they form a *plexus spermaticus* (s. *pampiniformis*), and with *vas deferens* and the *art. spermatic.* the spermatic cord. They leave the *vas deferens* on its entrance into the pelvis, and pass along the *m. psoas* (with *art. sperm.*) to *ven. cava inf.* [the right] and *v. renalis* [the left] ; the left behind sigmoid flexure (therefore frequently varicose [?]). b. *Ovaricæ*, from the *ovary, uterus, ligg. rotund.* ; they form, like *vv. testiculares*, a *plexus pampiniform.* at the orifice.
3. *Vv. renales*, the right is shorter and passes more obliquely upwards than the left, which receives the *spermatica sinistra*, and passes over in front of the *aorta*.
4. *Vv. suprarenales*.
5. *Umbilicalis* (see § 559).
6. *Vv. phrenicæ inferiores*, two for each *art. phrenica*.
7. *Vv. hepaticæ*, arise from the capillary rete formed by *vena portæ* and *art. hepatica* in the lobules of the liver, open with eight to ten small trunks along the *fossa venæ cavæ*, with two to three larger from the right and left lobes of the liver close under the *foramen quadrilaterum*, at an acute angle into the *vena cava*. They pass from before backwards (crossing also with the branches of *v. portæ* and *art. hepatica*), are not placed in a fibrous sheath, and are perforated like a sieve in their interior by the minute veins opening into them.

597.

I. *Venæ iliacæ communes.*

Origin: before the superior part of *symphys. sacro-iliaca* by the junction of *vv. iliacæ interna* and *externa*,—behind the division of *art. iliaca communis*. Termination: to the right of the superior border of the fifth lumbar vertebra. Course: obliquely upwards and inwards. Valves are wanting.

Iliaca communis dextra

is situated: behind and to the outside of *art. iliaca comm.*, is shorter, and receives no branches. It is not compressed by an artery, like the left common iliac vein.

Iliaca communis sinistra

is situated: internal to and behind its artery; at the mouth the *art. iliaca commun. dextra* descends before it from left to right; receives: *V. sacra media*.

1. *Iliaca interna* s. *hypogastrica* corresponds to the *art. hypogastrica*, and its branches (the *v. umbilicalis*, only, opens into *v. portæ*). Origin: generally from plexus, on the walls and in the organs of the pelvis, and in the external organs of generation. Course: ascends out of the pelvis before *m. pyriformis* and *symphys. sacro-iliaca*, is short. Position: behind and internal to the arteries of the same name. They and their branches are supplied with veins.

- a. *Plexus hæmorrhoidalis* surrounds the inferior extremity of the *rectum*, and the mucous membrane of the orifice of the *anus*, is formed by *Vv. hæmorrh. superr.*, branches of *v. mesenterica infer.*, and the *vv. hæmorrh. mediæ* and *infer.*; branches of *v. hypogastrica*.
 - b. *Plexus vesicalis*, in the male surrounds *Prostata* and neck of the bladder, is connected with *a*; receives the *vv. superficiales penis*, and gives off *vv. vesicales*. In the female it is smaller, and unites with *plexus vaginalis*.
 - c. *V. dorsalis penis* arises from the foreskin, passes (between its two arteries) upon the back of the penis, connected with the deep veins, and enters under the pubic angle through *ligam. pubo-prostaticum* to *plex. prostaticus*. In the spongy tissue of *corpp. cavernosa* arise the branches of *pudenda interna*.
 - d. *Plexus vaginalis* arises in the erectile tissue of the *introitus vaginæ*, connected with *plex. vesicalis* and *hæmorrhoid*.
 - e. *Plexus uterinus*. The veins of the uterus form large trunks not tortuous, at the lateral margins (*si'us uterini*), united together transversely, and possessing erectile fibres, like the tissue of the *Uterus*; they unite with the *vv. ovaricæ*.
 - f. *Vv. iliolumbalis, sacra lateralis, obturatoria, ischiadica, pudenda, glutæa*.
2. *Iliaca externa* s. *cruralis*, takes a course like the *art. cruralis*. In the

pelvis it is situated on the inside (and behind) in the femoral ring : on the inner side (crural hernia passes down before it) ; below the mouth of *v. saphena* : behind ; and at the inferior part of the thigh : on the outer side of the artery ; in the popliteal region ; behind, and rather outside the *art. poplitæa*. In the foot and leg the deep veins are double for each artery, but they take a similar course. The *v. iliaca externa*, only, does not possess valves.

Cutaneous veins (with very thick walls) :

- a. *Saphena interna* s. *magna*, arises from *plexus dorsalis pedis*, on the internal border of the foot, passes upon the dorsal surface of *os metatarsi I.*, and over the *tarsus*, curves from below upwards before the inner malleolus, then ascends on the internal surface to the posterior border of the *tibia* as far as behind *condyl. intern. femor.* (on the inner side of the tendons of *mm. semitendin., gracilis*, and *sartorius*), inclines to the front, and ascends along the anterior border of *m. sartorius* to the inner and anterior surface of the thigh, perforates the *fasc. cruralis*, and sinks one inch below the femoral arch into the *v. femoralis*. It receives the cutaneous veins of the thigh, of the anterior abdominal walls and *Vv. pudend. externæ*, and branches of the deep veins.
- b. *Saphena externa* s. *parva* arises from *plexus dorsalis pedis*, on the outer border of the foot, passes round behind the external malleolus, at first on the outer border of the *tendo Achillis*, then over this to the centre of the fibula, and thus to the popliteal region, where it sinks, between *nerv. tibialis* and *fibularis*, close to *v. articular infer. interna*. into the popliteal vein. It covers and crosses the *n. peronæus* twice. It receives branches from the sole of the foot and leg, unites with *v. saphena interna* at the malleolus and back of the foot ; and sometimes also opens into it.

598. II. *Vena portæ* s. *portarum*, the portal vein,

forms a tolerably independent system of vessels, the roots of which pass forth from the capillary rete of the organs of digestion, unite into one venous trunk, which again ramifies, in a dendritic manner, like an artery, in the liver, so that its blood passes along through the *vv. hepatica*, again into the circulation. It corresponds to *Artt. cæliaca, mesenterica superior* and *inferior*, with the exception of *art. hepatica*. Origin : from the *vv. mesenterica superior* and *linealis*, united at an acute angle, behind the head of the *Pancreas*, the *duodenum*, in the centre before the vertebral column, to the left of the *Vena cava inferior*. Course : from below upwards, and from left to right, four inches long, to the left extremity of the transverse fossa of the liver, in which it bifurcates. Situation : behind *cap. pancreatis* and *pars descend. duodeni*, *art. ductus hepaticus*, before *v. cava. infer.* ; within the *capsula Glissonii*, between the two layers of *lig. hepatico-duodenale*.

Branches : to the trunk of *ven. portæ* also pass *v. gastrica (sinistra) superior* and *cystica* ; from the trunk passes off in the *Porta (sinus v. portæ)* :

a. *Ramus dexter*, the shorter and thicker branch for the right lobe of the liver.

b. *Ramus sinister*, for the left and the two central lobes, receiving in the embryo the right branch of the umbilical vein, and gives off *ductus venosus Arantii*, which unites *v. portæ* and *v. cava inferior*.

The two branches pass off from one another at a right angle, quickly divide, continually becoming smaller, and form, at last, around the glandular lobules of the liver, a capillary rete, from which the *vv. hepaticæ* come off.

1. *Lienalis* s. *splénica* arises in the cells of the spleen, passes through the *Hilus* and transversely to the superior border of the *pancreas*, behind and below *art. lienalis*, towards the right to the *mesenterica superior*. It receives *vv. breves, pancreaticæ, gastro-epiploica sinistra*, and :

a. *V. mesenterica inferior*. This arises from *ven. hæmorrhoid. superior* in the *plexus hæmorrhoidalis* of the *rectum* (therefore connected with *v. hypogastrica*) and *vv. colicæ sinistra*; passes obliquely to the right and above *mesocolon descendens*, before the *vasa renal.* and behind the *pancreas* to the splenic vein, near to its confluence with *v. mesenterica superior*, in which it even often opens.

b. *Mesenterica superior*. It lies on the right and anterior side of the artery of the same name, arises from *vv. colicæ dextræ* and *intestinales, gastroepiploic. dextra*, and receives in the embryo the *v. omphalo-mesenterica* from the umbilical vesicle, which in the third month of fœtal life, together with its artery, again disappears.

Anastomoses of the portal vein : 1. between the *vv. hæmorrhoid. interna.* and *hæmorrhoid. interna.* 2. Between the veins of *colon transvers., descendens,* and *v. cava inferior.*

599. *Vena umbilicalis*, the umbilical vein, arises in the embryo from the capillary rete formed by the *two artt. umbilicales* in the *Placenta*. Passing through the umbilical cord and ring into the belly of the fœtus, it advances to the inferior surface of the liver (in the left anterior longitudinal sulcus), and bifurcates into a larger connecting branch for the left branch of the portal vein, and a smaller left (*ductus venosus Arantii*), which carries the blood into the *ven. cava inferior*. It becomes impervious (in one month) after birth, and then passes as *lig. teres hepatis*. It is larger than the portal vein of the fœtus, and valveless. Branches : about twenty small ones for the liver.

600. The Veins of the vertebral column,

to which also *vv. azygos* and *hemiazygos* belong, connect together the veins of all parts of the trunk, so that, if even one of the two cavæ is obstructed in any place, the circulation of the blood is, in consequence, uninterrupted. They are partly external, upon the arches of the vertebræ, partly internal, in the *canalis spinalis*, and they form *rete* in the whole length of the vertebral column.

1. Internal :

- a. *Plexus spinales interni anteriores*; they lie close upon the bones, on the posterior surface of the bodies of the vertebræ; they appear as a broad longitudinal canal, consisting however of transverse canals lying close together, with thin walls, connected at the *foram. magnum* with *sinus occipital.*; they receive the blood from the vertebræ and the *dura mater*.
- b. *Plexus spinales interni posteriores*; between *dura mater* and vertebral arches, the meshes are wider; they form a ring with the anterior plexus between two vertebræ, besides two canals passing close to the middle line; they anastomose with the :

2. External :

- a. *Pl. spinales externi posteriores*; they are placed with wide meshes upon the vertebral arches between the transverse and spinous processes; more narrow in the neck (*pl. colli poster.*) where there is an anastomosis with *sinus transversus*, (through *foram. condyloid. post.* and *mastoid.*)
- b. *Pl. spinales externi anteriores*; do not exist throughout the spine; *pl. colli anter., pl. sacralis.*

The Lymphatic vessels, *Vasa lymphatica s. resorbentia.*

I. The Trunks.

601. *Ductus thoracicus*, the thoracic duct,

the common trunk of the lymphatics of the entire inferior and the left superior half of the body, measures transversely in width two lines, has a few valves, and frequently divides into two or several trunks, which again unite.

Origin : before the first to the second lumbar vertebra, to the right of the *Aorta*, to the left of the right internal crus of the diaphragm, close under the *hiatus aorticus*; by the confluence of three (to six) short thick ramuli, the central one of which comprises the lymphatics of the organs of digestion (chyliferous vessels), whilst the lateral consist of the united lymphatics of the inferior extremities and the pelvis. One or two of the united ramuli is enlarged, one to two inches, before the commencement

of *duct. thoracic.*; the place is called *Ampulla* s. *cisterna (chyli) Pecqueti*, s. *receptaculum chyli*. Course: tortuous, before and through the *hiatus aorticus* upwards, rather to the right on the anterior surface of the bodies of the vertebræ, to the right of *aorta*, to the left of the *v. azygos*. Passing almost in the central line as far as to the front of the fourth dorsal vertebra, it inclines to the left behind the *aorta*, on the left side of *œsophagus*, passes out on the inner and posterior side of *art. subclavia sinistra* from the thorax, and curves, before the seventh cervical vertebra and behind the *v. jugular. intern. sinistra*, in an arched form outwards and forwards to the angle between *v. jugularis interna* and *subclavia sinistra*, where, provided with a valve, it opens singly or divided. Situation: the inferior part in the right, the superior in the left mediastinum.

602. 2. *Truncus lymphaticus dexter* s. *major*, the right lymphatic trunk,

receives the lymphatics of the right half of the head, neck, chest (the right lung, the right heart, and half of the liver and pharynx), and the right superior extremity; is in connexion by means of branches with *ductus thoracicus*. It arises: about one inch above the angle of *vv. jugularis interna* and *subclavia dextra*, in which it opens, from three small trunks, in which the lymphatics of the right arm from without, those of the right half of the chest from within, those of the head and neck from above, flow together. The small trunks sometimes open into the veins (*subclavia jugularis*).

603. II. The Lymphatics and Lymphatic glands of the inferior half of the body.

1. Inferior extremity.—a. Lymphatic glands:

1. *Glandula tibialis antica*, lies before and above *lig. interosseum*; is not always present; is formed by the deep lymphatics of the foot.
2. *Glandulæ poplitææ*, two to four small glands in the popliteal region along the *vasa poplitæa*, formed by the deep lymphatic glands.
3. *Gl. inguinales* (seven to twenty), surrounding the opening of the *v. saphena magna*, and are situated below the *lig. Pouparti*, in the fossa (*fossa ovalis*) between *m. psoas* and *pectineus* on the thigh, three inches in length, two in breadth. The deep (two, three to seven) are sometimes wanting, they are situated behind the *fascia cruralis* (round about the *vasa cruralia*), and unite through the opening in the last (where the *v. saphena* perforates) with the superficial, which lie upon the *v. saphena* and *proc. falciform.*, also, immediately with the *gl. iliacæ* by means of the femoral ring.

b. Lymphatics :

1. The deep accompany the deep-seated blood-vessels on the anterior and posterior surface of the inferior extremity. The anterior pass into the *gl. tibial. antica*, the posterior into the *gl. poplitæa*, and thence along the *v. cruralis* into the *gl. inguinal. prof.*
2. The superficial arise in the skin of the foot, the posterior partly from the sole, corresponding with *v. saphena parva*; the anterior come off from the back of the toes, incline inwards, ascend on the inner side of the leg, then upon *Sartorius* to the superficial inguinal glands, accompanying the *V. saphena magna*.
2. The surface of the external parts of generation. The *superficial* lymphatics of the *scrotum* and *penis* (or the inferior portion of *labia majora*), betake themselves to the deep and most superior inguinal glands, also those of the *rectum*; they correspond to the *vasa pudenda externa*.
3. Anterior inferior abdominal walls, the loins and buttocks.—Their superficial lymphatics, as well as some which accompany *vv. epigastric.* and *circumflex. ilei*, pass to the superficial and superior inguinal glands.
4. Internal surface of the pelvic and abdominal walls :
 - a. Lymphatic glands :
 1. *Gl. iliacæ externæ* (six to eight), along the *vasa iliaca externa* and *commun.* upwards to the fifth lumbar vertebra; three thereof are placed close behind the femoral ring on the outer, the inner, and anterior surface of the femoral vessels.
 2. *Gl. hypogastricæ* (nine to twelve), upon and close to *vasa hypogastrica*, are traversed by the lymphatics from the interior of the organs of generation (*vas. pudenda interna*).
 3. *Gl. sacrales* (four to five), laterally before the *promontorium* in the *mesorectum*.
 4. *Gl. lumbales* s. *aorticæ* (twenty to twenty-five), on the sides of the *aorta* (especially this) and *vena cava*, upwards.
 - b. Lymphatics :
 1. *Plexus iliacus externus*.—The lymphatics pass out of the inguinal glands, through *fascia cribriformis*, behind the *v. cruralis* into the pelvis, under the peritonæum to the *gl. iliacæ*, forming a plexus about the artery; on the other side to the *gl. hypogastricæ*, where they form
 2. *Plexus hypogastricus*, about *art. hypogastrica*, and also
 3. *Plexus sacralis* on the posterior pelvic wall, passing into the
 4. *Plexus lumbalis* (and *gl. lumbalis*). This plexus extends around the *aorta abdominal.* and *v. cava inferior*, receives the lymphatics of the kidneys, testicles, and spermatic cords, and the female internal organs of generation, and forms the lateral roots of the *ductus thoracicus*.
5. Of the urinary organs :
 1. Lymphatics of the kidneys and supra-renal capsules, are superficial and deep. The last pass forth at the *hilus* of the kidney, form plexuses,

and open into the *plexus lumbalis*, after they have united with those of the supra-renal capsules, and received those of the ureters.

2. Lymphatics of the urinary bladder open into *plexus hypogastricus*.
6. Organs of generation :
 1. Lymphatics of the testicle pass in the spermatic cord, and in the spermatic vessels, forming a *plexus spermaticus* to the *plex. lumbalis*.
 2. Lymph. of *corpora cavernosa* pass with the *art. pudenda* under the *symphysis pubis* to the *plex. hypogastricus*, to which also those of the seminal vesicles and preputial glands proceed.
 3. Lymph. of female internal organs of generation. Those of the *collum uteri* pass to the *plexus hypogastricus* and *plexus sacralis*; the remaining lymphatics of the *uterus* to the superior angles of the last, and thence, united with those of the *tubæ*, the *ovaria*, and *ligg. lata*, with the *vasa spermatica* to *plex. lumbalis*.

604. III. The Lacteals [lymphatics] and Lymphatic Glands of the organs of digestion.

1. Small intestines.—a. Lymphatic glands.

Gland. mesentericæ, 130 to 150, and situated in rows between the laminæ of the *mesenterium*, the largest at the origin, and at the extremity of *vasa mesaraica superiora*. The former, are *gl. duodenales*, they lie before the *duodenum*; the latter are *gl. ileo-colicæ*, in the angle between *ileum* and *colon*. (They readily inflame.)

b. The lymphatics are particularly numerous in the so-called *Jejunum*. The superficial arise from the serous and muscular coats; the deep, *vasa lactea*, which, during the process of digestion carry white chyle from the villi of the mucous membrane, and pass from gland to gland around the *truncus cæliacus*, to form the middle root of the *ductus thoracicus*.

2. Of the large intestines. a. Lymphatic glands.

Gland. mesocolicæ, twenty to fifty, are placed connected with the *gl. mesentericæ*. They are most numerous in the *mesocolon transversum*, along the vascular arches of *art.* and *vv. colicæ*.

b. Lymphatics. Those of the *cæcum*, *colon ascendens*, and *transversum*, pass through *gl. mesocolic.* to the *gl. mesentericæ*; those of the *colon descendens* and *rectum* to the *gl. lumbales* and *sacrales*.

3. Of the stomach. a. Lymphatic glands.

1. *Gl. gastro-epiploicæ superiores* (four to six) are situated in the small omentum on the small curvature along the *art. coronar. ventric. sinistra*.

2. *Gl. gastro-epiploicæ inferiores* (six to eight) in the great omentum on the great curvature, along the *art. coron. ventric. dextra*. They are especially accumulated about the *ostia pyloricum* and *cardiæ*, and they send their *vasa efferentia* to the *gland. cæliacæ*.

b. Lymphatics. The superficial form a plexus beneath the peritoneal investment; the deep, likewise, upon the mucous membrane, and they incline,

partly, to the great, partly to the lesser curvature, to the *gl. lienales* and *gl. pyloricæ*.

4. Spleen and Pancreas. a. Lymphatic glands.

1. *Gl. lienales* are placed in the *hilus* of the spleen.

2. *Gl. pancreaticæ*, at the superior border of the *pancreas* along the *art. splenica*.

b. Lymphatics. Those of the spleen are said to carry a red lymph (Hewson); the superficial come from the covering, the deep from the Parenchyma; they form a *plexus* in the *hilus*, and pass, with the lymphatics of the *pancreas*, along the *art. lienalis* to the *gl. celiacæ*.

5. Of the liver. a. Lymphatic glands.

1. *Gl. hepaticæ*, small glands, in the porta, they pass into the

2. *Gl. celiacæ* (sixteen to twenty), which are placed round about the *trîpus Halleri*, receive the lymphatics of the superior organs of digestion, and assist in forming the lateral roots of the *ductus thoracicus*.

b. Lymphatics. Those upon the superior surface of the liver pass partly forwards through the diaphragm behind the *proc. ensiformis* to the *gl. mediastinæ anticæ* (others to the smaller curvature of the stomach), partly from before to the posterior border; on the inferior surface of the liver they pass from before, backwards: those which pass to the right of the gall-bladder, to the *gl. lumbales*; those which lie to the left, to the *gland. cardiacæ*; those which surround the gall-bladder in a plexus, to the *gl. hepaticæ* and *celiacæ*. The deep lymphatics pass out on the *ductus hepaticus*, and the *Ven. portæ* inside the *capsula Glissonii*, and proceed to the same glands.

605. IV. Lymphatics and Lymphatic glands of the superior half of the body.

1. Of the superior extremity. a. Lymphatic glands.

1. *Gl. cubitales*, two to three superficial in the bend of the elbow, three to four deep at the same place above *condyl. internus*, behind *v. basilica*.

2. *Gl. brachiales*, five to seven small glands along the *art. brachialis*.

3. *Gl. axillares*, ten to twelve in the axilla, and round about *art. axillar.*, connected by means of a *plexus axillaris*; they receive the lymphatics of the superior extremities and thoracic parietes, and pass with four to five *vasa efferentia* into the *plexus subclavius*, and thence into the *truncus communis*.

b. Lymphatics. The superficial pass with *vv. cephalica* and *basilica*, the deep with the arteries; both terminate in the *gl. axillaris*.

2. Of the external walls of the thorax.—The lymphatics of the anterior and lateral parietes ascend over *m. pectoralis* and *serratus major* to the *gl. axillares*; those of the posterior walls upwards and downwards (under the tendon of *m. longis. dorsi*), to the same.

3. Of the internal thoracic parietes. a. Lymphatic glands.

1. *Gl. intercostales* (sixteen to twenty); they are small, and lie close to the dorsal vertebræ on the anterior surface of the heads of the ribs; some*

between the *mm. intercostales* ; they send their *vasa efferentia* into *ductus thoracicus* and

2. *Gl. mediastinæ posteriores* (eight to twelve). They are placed along the *aorta thoracica* and *œsophagus*, receiving the lymphatics of the *œsophagus* and *pericardium*.
3. *Substernales*, they pass along the *art. mammaria interna*, one in each intercostal space, close to the sternum.
4. *Gl. mediastinæ anteriores* are placed, partly (three to four) upon the diaphragm before the pericardium, partly (eight to ten) round about the *arcus aort.*, *ven. cava superior* and *innominata* at the *basis cordis*. Their *vasa efferent.* come from the convex surface of the *liver*, the *diaphragm*, *pericardium*, the *thymus*.

b. Lymphatics :

1. *Plexus intercostales* consists of the deep lymphatics along the *artt.* and *vv. intercostales*, receive the lymphatics of the vertebral columns, pass through *gl. intercostales* and *mediastin. poster.*, and into the *duct. thoracicus*. They have roots in the *mm. intercost.* and *pleura costalis*.
2. *Pl. mammarius internus*. The lymphatics of the superior half of the anterior abdominal walls ascend behind *proc. ensiform.*, united with those on the external surface, by means of the *gl. substernales* as high upwards as the *gl. cervicales inferiores*, and into the *ductus thoracicus* and *truncus lymph. dexter*.

3. The lymphatics of the diaphragm pass to the *pl. intercost.* and *hepatic.* and to the *gl. substernales*.

4. Of the Thoracic viscera: a. The lymphatic glands. *Glandulæ bronchiales* s. *Vesalianæ* (twenty to thirty, larger) are situated along the *bronchi* and their point of bifurcation, the largest usually at the division of *trachea*, the smallest (*gl. pulmonares*) penetrate the substance of the lungs. In youth yellowish white, they become in time (from the tenth year onwards) darker, blue and black, and readily ossify.

b. Lymphatics of the lungs. The superficial form beneath the *pleura* a close rete and pass, generally inwards to the *gl. bronchiales* at the roots of the lungs. The deep arise from the lobes of the lungs and pass to *gl. bronchial.* and *gl. œsophageæ*. *Vasa efferentia* of the bronchial glands pass to *gl. tracheales* and *œsophag.* and with these into the *ductus thoracicus* and *trunc. lymphatic. dexter.*; several also into *v. jugularis interna*.

c. Lymphatics of the heart. The superficial, beneath the *membr. serosa*, generally pass on the right border; the deep arise from the internal membrane of the heart; they pass with the last from the pericardium, and sink into the *pl. aorticus* before *aorta* and *art. pulmon.*, and into the *ductus thoracicus*. The lymphatics of the *thymus* gland and *pericardium* pass into the *gl. substernales*, *mediastin. anteriores* and *bronchiales*.

5. Of the head and neck. a. lymphatic glands of the head.

1. *Glandulæ subauriculares*, under and behind the auricle, behind the insertion of *m. sterno-cleido-mastoid.*; they are, like the rest (*gl. mastoideæ*,

occipitales) of the lymphatic glands of the skull (which are only found on the back of the head) very small and less numerous.

2. *Gl. submaxillares*, the largest in the face, they lie at the *basis mandibulæ* (eight to ten) and along the *art. maxillaris*; they open into *gl. cervicales superficiales*.

3. *Glandulæ parotideæ*, deep, lying superficially between *parotis* and *m. masseter*.

4. *Gl. zygomaticæ*, under the zygoma, they open into *gl. submaxillares* and *cervical. superf.*

5. *Gl. faciales profundæ*, behind *m. buccinator*, and on *art. maxillar. interna*, they receive the deep lymphatics of the face; its cavities and the *dura mater*; they open into *gl. cervical. profundæ*.

b. Lymphatics of the head. The superficial accompany the *art. temporal. superf.* to the *gl. parotid.*, and the *art. occipitalis* to *gl. mastoideæ*. The deep *vasa lymphatica meningeæ* pass on the *art. and v. meningeæ med.* to the *gl. jugulares*. No one has, at present, been able to follow lymphatics into the substance of the brain. The superficial lymphatics of the face pass along the blood-vessels to the *gl. submaxillares*; the deep pass out from the temporal, and pterygo-palatine fossæ and the nasal cavities. Those of the *tongue, pharynx, velum palati* and *larynx*, open into the *gl. faciales prof.* and *gl. cervicales*.

c. The lymphatic glands of the neck are placed upon its anterior surface.

1. *Gl. cervicales superficiales* are situated generally along the *V. jugular. externa*, in the triangular space between *clavicula, mm. sterno-cleido-mastoid.* and *trapezius*, covered by *platysmamyoides*; also several small ones under the *os hyoides*.

2. *Gl. cervicales profundæ* pass in numbers along the *V. jugular. and carotis intern.*, from the *process. mastoid.*, as far downwards as the superior opening of the cavity of the thorax, before the vertebral column on the sides of the *pharynx* and *œsophagus*, and are connected with *gl. tracheales*.

d. The lymphatics of the neck come from the *pharynx, œsophagus, larynx, trachea*, pass through the *gl. cervicales*, and out of these into a common trunk, which empties itself upon the left side into the *ductus thoracicus*, upon the right into the *truncus lymphaticus dexter*.

OF THE NERVES.

NEUROLOGIA.

“The knowledge, then, of what is termed the Economy of an Animal Body is to be acquired only by an intimate acquaintance with the distribution and uses of the nerves; and this knowledge of the natural relations leads directly to the comprehension of the signs of disturbed function, or the symptoms of disease.”—Sir C. BELL. *The Nervous System of the Human Body*. Preface, 3d edition.

“At first this intricate network seems accidental; neither arrangement nor system is apparent; but when the minute twig discovered by one anatomist in London is as surely found by another at Pavia, as two astronomers, at different spots on the globe, trace in the heavens, with the same certainty, the discoveries of Herschel, there can no longer be a doubt of the nerves being distributed with regularity and system.

“There is no such thing as a nerve deviating or being wanting (an occurrence frequent in the vascular system), without the loss of some essential faculty.” Introduction.

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THE NERVES, *NEUROLOGIA*.

606. The nervous system, *systema nervosum*, the organ of psychical life, of sensation, and (in reciprocal action with the muscular tissue) also that of motion, consists of two principal portions, the central and peripheral, both of which are uninterruptedly united together, and are not even different in substance. The central nervous mass is compressed into the cranium and medullary canal of the spine; the peripheral penetrates (as nerves) the organs of the body, and spreads itself out like the branches of a tree from the central portion.

607. 1. *The tissue of the Nervous system.*

It consists of two portions, opposed to one another, which are found in the nerves as well as in the central portions; these are:

608. a. *The primitive fibres.* They are cylindrical, isolated in their whole course, undivided, with soft, peculiar contents, and surrounded by a delicate envelope. In the nerves we observe an external sheath, consisting of fibres of uniting tissue, which, taking a longitudinal direction, are connected with the envelope of the whole nerve, and an internal delicate limiting membrane, which appears to consist of fibres arranged spirally, and closely surrounds the nervous contents (neurine) of the primitive fibre. Both sheaths become transparent by means of dilute acetic acid. The neurine is (in the fresh state) homogeneous, milk-white, soft, readily coagulated by cold, alcohol, common salt, &c., and then presents in the middle a central stripe (*cylinder axis Purkinje*), which is not yet coagulated. In consequence of yielding or laceration, whilst macerating in water, the primitive fibres appear knotty (varicose). In the *central parts*, the primitive fibres are more delicate, and are not surrounded by an external sheath; but they are, otherwise, in the same condition as in the nerves. They form the *white* substance of the former.

609. b. *Ganglion globules (globuli gangliorum)*, the nucleated bodies of the nerves, form kidney-shaped, three or four-cornered cells, in which is found a clear vesicular *nucleus*, and within this a *nucleolus*. The contents of the cell are soft, granular, brownish yellow, or gray. The nucleolus yellowish brown, solid. They are probably surrounded by an internal sheath, but fixed by an *external* (often reddish) fibrous capsule. They are placed in masses

between and round about the primitive nervous fibres. Their external vaginal processes give a weak, gray appearance (especially to the *n. sympathicus*), misled by which they have been regarded as vegetative, organic, nervous fibres, since they stand in relation with forms of uniting tissue, only (Valentin).

The ganglion globules of the central portions are extremely delicate and difficult to isolate; the vaginal formation is here, also, doubtful. They form the gray, yellow, and brown substance of the brain and spinal marrow.

The white or medullary substance is formed of primitive fibres. The gray or cortical substance of ganglion globules; it is more plentifully supplied with vessels than the white.

610.

2. *The chemical elements.*

The medullary substance of the brain consists of four-fifths water; Cholesterine; Cerebric acid, free, or united with soda or phosphate of lime; Oleophosphoric acid, free, and with soda; Oleine and Margarine; Oleic and Margaric acids; Albumen, with sulphur (Frémy). Moreover, the sheaths of the nerves, with vessels and uniting tissue, are to be attended to in the examination. The medullary substance contains more fat, the cortical substance more albumen, the spinal marrow more fat and less albumen, the nerves more albumen than the brain. (Vauquelin).

611. *The peripheral portion of the Nervous system,*

nerves, *nervi*, are long portions formed of bundles (*fasciculi*), lying close together, and cords (*funiculi*) of primitive fibres, which place the surfaces of the body and muscles in connexion with the central portions, and are, partly, the conductors of sensations from the periphery to the centre; partly, the conductors of movements from the latter to the former. There are two kinds, white and gray:

The white nerves (animal or cerebro-spinal) are strong, bright, transversely striped, spread out in the muscles of the trunk and in the skin, and are surrounded by a sheath of strong, fibrous, uniting tissue, the Neurilemma, which blends, externally, with the amorphous uniting tissue of the surrounding parts; internally, in the outer sheath of the delicate nervous fasciculi (see before). The primitive fibres of the white nerves (diam. 0.080—0.084 of a line) are strongest in the muscles of voluntary motion, and most delicate in the nerves of the senses.

The gray nerves (vegetative) are soft (see *nervi molles*), but tolerably strong, diaphanous, reddish gray, not transversely striped; their neurilemma very strong, and provided with an annular layer.

They form a plexus about the vessels (which serve for their support), and proceed to the involuntary muscles (see *n. sympathicus*). The more primitive fibres there are found in them, the more they resemble the white nerves, e. g. the nerves of the heart.

1. Course. Every primitive fibre passes uninterruptedly, and without branches, from the central to the peripheral extremity, generally outwards and downwards. The nerves mostly enter the organs from within; or rather, they pass to their actually free surface.

2. Combinations take place in this way, only that fasciculi pass over from one nervous trunk into another, the primitive fibres always passing in an isolated condition, never coalescing with one another. The different kinds of combination are as follows :

a. *Anastomosis, loops*.—A part of the fasciculus of a trunk is detached, and passes away as a distinct branch (*ramus*). It goes into the sheath of another trunk, and applies itself to this, thus forming a simple anastomosis. When an interchange of fasciculi takes place between two trunks, a reciprocal and decussating anastomosis arises.

b. An interlacement, *plexus*, signifies the combination of anastomosing branches into a network, the meshes of which are empty, or are filled by other tissues. From each root of the plexus each of the nerves passing off from it contains, at last, separate fasciculi. *Plexus gangliosus* signifies a plexus, the meshes of which are filled up with ganglion globules.

c. Nervous ganglia, *ganglion nervosum*, is a smaller or larger intumescence, formed by the accumulation of peripheral ganglion globules. In addition to these, their sheaths and vaginal processes, a larger or smaller number of primitive fibres are found in it which pass through the ganglion, singly, or forming a plexus, and entwining about the globules. The ganglion is surrounded by a strong neurilemma, in which the capillary vessels ramify.

612. 3. *Origin and terminations*. The roots of the nerves are the immediate continuations of the primitive fibres of the brain and spinal cord. The posterior roots contain finer, the anterior coarser, fibres. United into fasciculi and trunks, they divide, as before described, and, finally, spread out in the substance of the organs *in loops*, so that the primitive fibre is reflected at its extremity and returns to the centrum, no proper termination to it being present.

The plexus, in which the terminations of the nerves resolve

themselves, are, like the capillaries, variable, according to the organs into which they enter.

In the contractile tissues (muscles, and so forth), the nerves are said (by C. Burdach) to terminate with narrow loops, in the parts endowed with sensation (the skin, organs of the senses, &c.), with plexuses and wide loops.

Moreover, each single muscular fibre and cell of an organ is not pervaded by a corresponding nerve fibre.

4. The vessels (capillary and lymphatic) of the nerves are dispersed in their neurilemma.

[Pacian bodies, corpuscles. Observed by Pacini in 1831. "Small corpuscles or globules, of an elliptical figure to the eye, dull white or opalescent, of about two-thirds of a line long, lying attached to the digital branches of the median and ulnar nerves." They are also found along the nerves of the sole of the foot.—See the article in *Cycl. of Anat. and Physiol.*].

613.

The Central parts,

brain and spinal cord, consist of the same elements as the peripheral. The primitive fibres and ganglion globules are accumulated in masses, and united into definite shapes, which are not separated from one another by means of external sheaths.

The white substance consists of fasciculi of primitive fibres which are continued from the nerves, interlace, decussate, and either pass through the gray substance of the central organs or receive it between them. According to Valentin there are, even here, no terminations to the nerves; but, as in the peripheral, only places for their reflection; so that every primitive fibre is closed in a circular manner, and by that it might be decided that in the central organs no other fibres exist as such which continue into the nerves.

The gray substance exists under different colours, partly as external (the cortex of the brain), partly as internal (in the spinal marrow) masses, in the deep layers of which (in the brain) fibres are also found, together with the ganglion globules (Lauth).

1. The spinal cord sends off from thirty-one to thirty-two nerves upon either side, the posterior roots of which are subservient to sensation, those of the anterior to motion. Higher upwards the fibres of these roots decussate in the *medulla oblongata*, as the right pass off to the left, and the reverse. From this point (almost) all the fibres pass upwards into the brain through *Pons Varolii* in the *crura cerebri*, and partly into the *cerebellum*.

According to Budge, the spinal cord contains motor fibres in its

whole thickness; according to Valentin, the nervous fibres of the flexor muscles are situated in the anterior columns of the spinal cord and pass over those of the extensor muscles in the posterior. The motor and sensitive nerves of the viscera pass along in the spinal marrow (See *N. sympathicus*).

2. The brain sends off twelve pairs of nerves. These are, partly, nerves of sensation (and of the senses), partly nerves of motion, and partly of both together (mixed nerves). They are abstractedly of the three nerves of the higher senses (for smell, sight, hearing), which may be considered as parts of the brain, in accordance with the spinal nerves, and the skull has been regarded as consisting of three vertebræ. Accordingly there might be an anterior (*n. oculo-motor, abducens trigeminus*) and a posterior intervertebral nerve of the skull (*N. glossopharyng., vagus* with *accessorius* and *hypoglossus*). We cannot, however, refer to, in all, an anterior and posterior root. They arise from the posterior part of the basis of the brain.

The hemispheres of the *cerebrum, corp. callosum, hypophysis* and *pineal gland*, are the means neither of motion nor sensation; it appears, accordingly, as if the mental functions (thought) were dependent upon them.

In the *cerebellum* the nerves of the large intestines, of the bladder and organs of generation, terminate; in the optic tubercles and striated bodies those of the stomach and small intestines; in the *corpora quadrigemina* (by going through *Pons Varolii*) the nerves of the trunk.

The *vessels of the central parts* are very fine, and consist of the primary vascular coat only; they form close rete in the gray, but are more sparingly diffused in the white substance. They spread out on the surface in the *pia mater* (see after), and from here supply the substance (and from the processes which the last sends into the cerebral cavities, as *plexus choroidei*). The arteries quickly pass into capillary vessels. Lymphatic vessels are not known in the substance, but probably in the envelopes. For the membranes of the brain, see Brain and Spinal Marrow, § 624.

614.

The Brain, *Encephalon*,

is a mass consisting of nervous substance, which, surrounded by three concentric membranes, fills up the cranial cavity, and contains, in its interior, four spaces connected together. Its surface is covered by a gray (cortical) substance, from one to one and a half lines thick, the (medullary) substance lying under that is white.

Weight: from three and a half to four pounds and one-third; greatest longitudinal diameter, six inches; transverse, five inches; vertical, four and three-quarter inches. It is divided into the three following portions:

615. 1. The great brain, *cerebrum*, fills up the cranial cavity, with the exception of the *fossæ occipitales inferiores*, is semi-oval, four inches deep, about three pounds weight, and rests with its basis upon the anterior and central cranial fossæ, and upon the *tentorium cerebelli*. A deep fissure divides the *cerebrum* into two lateral halves or hemispheres, of equal size, each of which contains, in the interior, a cavity (*ventriculus lateralis*), consists of three lobes, and which, on the surface, are distinguished by the convolutions, *gyri*, like intestines, which are limited by irregular fossæ (*sulci*) not very deep, and which do not generally correspond upon the two hemispheres. On the inferior surface of the brain we see, in the middle from before to behind, proceeding from the centre of the brain, also before and between the *crura cerebri*, a perforated place, the *substantia perforata media*, before it two roundish tubercles, *corpora mamillaria*, before these a gray enlargement, *tuber cinereum*, elongated into the *infundibulum* to which the *glandula pituitaria* is connected. Before the *tuber cinereum* the decussation of the optic nerves presents itself. Upon both sides of the *basis cerebri* we see the *fossa Sylvii*, which separates the anterior from the middle cerebral lobes, and the origin of the twelve pairs of nerves, of which the olfactory nerve is situated in a particular excavation. Behind that part of the hemispheres which is situated over the *cerebellum* is a little hollowed out. On the external surface of the brain we see a fissure, the continuation of the *fossa Sylvii*, which separates it into a horizontal and ascending portion. The superior surface presents the great longitudinal fissure, *fissura cerebri longitudinalis*, and the irregular *gyri* and *sulci*. On the internal surfaces of the hemispheres, which are turned towards each other, there is a tolerably constant *gyrus fornicatus* which forms an arch around the great cerebral commissure. We generally admit three lobes on each hemisphere; but according to Arnold and others we must receive five, an anterior, middle, superior, posterior, and the *Insula* or *lobus intermedius* (according to Burdach, *lobus caudicis*). The last presents the *gyri breves*.

616. 2. The small brain, *cerebellum*, is situated in the inferior cranial fossa, covered by the *tentorium*. It projects a little behind the posterior cerebral lobes, is roundish and flattened from above downwards; its transverse diameter measures four inches, its lon-

gitudinal two and a half, the vertical two. Weight, four ounces ; it is said to be greater in the female than in the male (*Cuvier*). In proportion to the size of the great brain in children = 1 : 20, in the adult = 1 : 7. Its superior surface is divided by a projecting line from before to behind into two sloping, its inferior by a fissure, *vallecula*, into two rounded lateral halves, *hemisphæria cerebelli*, which are convex below, and have between them at their posterior circumference a triangular space, which receives the *tentorium* and the *crista occipitalis interna*. The anterior boundary presents a crescentic excavation, *incisura marginalis anterior*, which surrounds the *corpp. quadrigemina* ; before it *protuberantia annularis* is situated ; and from it proceed the *crura cerebelli ad pontem*, *ad corpp. quadrigemina* and *ad medullam oblongatam*. Between the two hemispheres the *process. vermiform.* is situated, which is divided by a transverse fissure, *sulcus transvers. Reilii*, into a superior and inferior portion, and forms the roof of the fourth ventricle. Other transverse fissures give to the surface of the lesser brain a laminated appearance.

617. 3. The central portion of the brain, *mesencephalon, isthmus encephali*, consists of several parts at the basis and in the interior of the brain, which unite together the large and small brains and the spinal marrow. To this belong : *medulla oblongata*, *pons Varolii*, *crura cerebri* and *corpp. quadrigemina*.

Parts of the Central and Great Brain.

618.

I. On the Basis.

1. The *medulla oblongata*, the conical enlargement at the superior extremity of the spinal marrow (*bulbus medullæ*), the immediate continuation of which it is, and with which it forms an obtuse angle, is from fourteen to fifteen lines long, nine broad, six thick ; it commences at the *foramen magnum* and terminates at the *pons Varolii*, as its anterior surface rests upon the *clivus*. It contains white and gray substance intermingled, and presents on its anterior surface a longitudinal fissure which goes as far as the *pons*, and a posterior which expands into the fourth cerebral ventricle. On each half, which arises by this arrangement, we see three enlargements :

a. *Corpora pyramidalia*, the anterior pyramids, lying close together. Each of these is a white narrow (below one line and a half, above two lines) fasciculus of fibres which decussate with the fibres of the other side in its inferior third only, and above pass into the *pons Varolii*.

b. *Corpora olivaria*, much shorter than the last (six lines long), on the outer side of which they are placed, directed downwards and inwards. Above they are separated from *pons Varolii* by a deep fossa, below they are bounded by arched fibres, internally by the roots of *N. hypoglossus*, and they reach as far as the central line. On their outer border, fasciculi of fibres ascend from the spinal cord (*funiculus siliquæ externus*), and pass through *pons Varolii* to the sides of *corpp. quadrigemina* (*crura ad corp. quadrig.*), and form the superior roof of the *aquæductus Sylvii*.

The posterior surface of the medulla oblongata is covered by the cerebellum, and presents above a V-shaped fissure, *calamus scriptorius*, which forms the anterior wall of the fourth ventricle; externally the

c. *Corpora restiformia* s. *crura cerebelli inferiora*, the posterior pyramids, the superior extremity of which is enlarged in the form of a nipple, and are, in a manner, the roots of the cerebellum, consist of tortuous fibres.

2. *Pons Varolii* s. *protuberantia annularis*, white, cubical, placed above *med. oblong.* from the centre of *clivus* to the *proc. clinoid. postt.*, in a depression before the small brain, below the *corpp. quadrigem.* and the *cerebrum*. In the middle of the *inferior* surface, directed obliquely upwards and forwards, it presents a longitudinal sulcus (for *art. basilaris*), on the sides of which the prolongations of the *corpp. pyramidalia* proceed; farther, transverse fibres, from which the *crura cerebelli* pass off; and from between which *N. trigeminus* arises. From the anterior border, the *crura cerebri* pass forth; from the lateral, the *crura cerebelli*; at the posterior, the pyramids enter. The superior surface forms the floor of the fourth ventricle.

3. *Crura cerebri*, two thick, cylindrical, white cords, six lines long, diverging from the anterior border of the *pons*, forwards, upwards and outwards to the great brain, where they become broader and flatter, and are embraced by *tractus nerv. optico-*rum. Below and at the sides free, they unite above with the *corpp. quadrigemina* and *crura cerebelli superiora*. They form the continuations of the pyramids. Between them is a triangular space which is filled up by the three following parts:

4. *Substantia perforata media, basis ventriculi 3*; this gray perforated plate consists of two triangular fasciculi (separated from the *crura cerebri* by a black line), and forms the posterior part of the floor of the third ventricle. Here arises *N. oculomotorius*.

5. *Corpora mamillaria* s. *bulbi fornicis*, two half globules, the

size of a pea, externally white, internally gray, (in the foetus, one only,) separated by a fissure, united by means of gray matter; they form the extremities of the anterior, descending crura of the *fornix*.

6. *Tuber cinereum*, a gray, soft mass in the triangular space between (and before) the *corp. mamillar.* and *tracti optici*, the floor of the third ventricle; above it lies the *commissura anterior*; under it the

7. *Infundibulum*, a reddish, hollow body, directed obliquely forwards, two lines long, to which

8. *Hypophysis* (s. *glandula pituitaria*) is attached. It consists of an anterior larger and whiter, and a posterior smaller and yellowish lobule, lies in the *sella turcica*, is very vascular, and weighs from five to ten grains; on its sides the *plexus cavernosi*. In the foetus and the lower animals hollow.

9. *Tractus nervorum opticorum*, two white, flat bands, fifteen lines long, arising behind from *thalamus opticus* and *corp. geniculatum*; they wind around the *crura cerebri* on the outside and behind, at the place where they enter into the brain, then pass, on the outer side of *tuber cinereum*, inwards and forwards, and unite before the *tuber cinereum*.

10. *Chiasma nervorum opticorum*, a quadrangular flattened ganglion, the internal fibres of which decussate, while the external pass directly forwards; it lies before the *hypophysis*, behind the *lamina cribrosa*. Its anterior border is united, by means of a vertical *lamina terminalis*, with the anterior commissure, which is situated above it. From this the optic nerves pass off.

11. *Lamina cribrosa cerebri* s. *substantia perforata anterior*, a thin, white plate before the *chiasma*, perforated by many vessels, bounded in front by the commencement of *corp. callosum*. From it the olfactory nerves arise.

619. II. The Azygos Parts in the centre of the Cerebrum.

1. *Corpus callosum* s. *commissura maxima*, a white flat band, three and a half inches long, eight to ten lines broad, and two to three thick, in the centre between the great hemispheres (one inch distant from their anterior, two from their posterior border), visible from above in the deep longitudinal fissure, consisting of transverse fibres (*striae transversae Willisii*). Its superior arched surface presents two longitudinal *striae* (*striae longitudinales Lancisii*), between which a slight depression is found (*raphe*); upon it the *art. callosæ* and the free border of *falx cerebri* are situated. Its

inferior concave surface forms upon either side the roof of the lateral ventricle, is situated in the middle line, *in front*, above the *septum*; *behind*, above the *fornix*. Its posterior thick and free extremity (*splenium*) with the *lyra* s. *psalterium*, that is, the inferior transverse fibres, covers the *corpp. quadrigemina* and *coronarum*, and touches the *monticulus cerebelli*. Its anterior extremity is reflected upon itself (*genu*), and passes from above downwards and from before backwards, terminating, in a beaked manner (*rostrum*), before the *commissura anterior* at the *basis* of the *cerebrum*.

2. *Septum pellucidum*, the translucent partition, a thin, triangular, vertical plate higher before than behind, expanded between the anterior part of *corp. callosum* and the *fornix*, consists of two layers (between which the *canal. septi pellucidi* [fifth ventricle]), and forms the internal walls of the lateral ventricle.

3. *Fornix*, a)(shaped medullary arch, passing in the direction of the *corp. callosum*, consists of two laminæ which, beneath the *septum*, are placed close to one another, between and upon the optic tubercles, and before and behind separate from each other. Its *anterior crura* (*columnæ*) incline downwards and forwards around the optic tubercles, in consequence of which a semilunar space, *foramen Monroi*, arises (through which the lateral communicates with the third ventricle). They then curve between *thalamus* and *corpus striatum* to the *corp. mammillaria*, and, from these, may be traced, as far as *tænia semicircularis* and *corpp. quadrigemina*, backwards, to the optic tubercles. Its *posterior crura* are more widely separated from one another (between them the *lyra*), and curve round the posterior surface of the *thalamus* outwards and downwards to the *pedes Hippocampi* in the lateral ventricles.

4. *Conarium* s. *glandula pinealis*, a conical reddish-gray corpuscle (four lines long, two to three lines broad), between the two anterior of the *corpp. quadrigemina*, invested with *Pia mater*, surrounded by *Vv. Galeni*, is situated behind the *commis. posterior* of the third ventricle, below the *lyra*, its free apex directed backwards. It is connected by means of two crura with the optic tubercles, is sometimes hollow, and contains the yellow and white sand of the brain (phosphate and carbonate of lime).

5. *Corpora quadrigemina* s. *bigemina* (*lobus opticus* of the lower animals), are the two larger anterior (*nates*) and the two smaller posterior (*testes*) elevations which are situated in a quadrangle of ten lines long and eight broad at the superior extremity of the *crura cerebri* above the commencement of *aquæduct. Sylvii* (hence

pons Sylvii) under the *splenium fornicis*, before the *cerebellum*, behind the optic tubercles. In front fibres pass to the optic tubercles and the *commissura posterior* of the third ventricle, behind they enter the *crura cerebelli superiora*.

620. The Ventricles of the Brain.

1. The lateral ventricles, *ventriculi laterales s. tricornes*. Each hemisphere of the cerebrum contains a large L-shaped cavity, which is situated rather towards the *basis*, separated from the other by the *septum pellucidum* and *fornix* only, and in communication by means of the *foram. Monroi*. It is partly filled with the *plexus choroideus*. Its roof (*centrum semiovale Vieussens*) consists of the transverse fibres of the *corp. callosum*. We distinguish four portions :

a. *Cella lateralis*, the lateral chamber, is the central, superior, longitudinal space, which is deeper internally in the angle between *septum* and *fornix* on the one side, and *thalamus* and *corp. striatum* on the other, than externally. *Corp. striatum* and *thalamus* form its floor.

1. *Corpus striatum*, a club-shaped, gray mass, perforated by veins, which passes backwards into a point, and is situated in a deep fossa on a plane with the *insula (foss. Sylvii)*, on the outer side of *thalamus*. It is traversed by white striæ which penetrate the *thalamus*.

2. *Thalamus nervi optici*, the optic tubercle. Its *superior*, vaulted, longitudinal surface looks into the lateral ventricle (covered by *plexus choroides*); before it the anterior crus of the *fornix* curves downwards; the *corpus striatum* surrounds it externally (separated by *stria cornea [tenia semicircularis]*), with which it forms a *centrum* for the hemisphere, and is associated with that of the *thalamus* of the other side by means of *commissura mollis*; its *internal* vertical surface forms the lateral wall of the third ventricle; *below*, it receives the *crus cerebri* in an excavation, and behind and internally it joins the posterior commissure. Quite internally on the posterior surface, above the *crus cerebri*, external and internal to the *corpp. quadrigemina*, are situated upon either side the two geniculate bodies, the *corp. geniculatum internum* which passes into one of the anterior, and *externum* which blends with one of the posterior of the *corp. quadrigemina*.

3. *Stria cornea [tenia semicircularis]*, a white, band-like, me-

dullary stripe between *corp. striatum* and *thalamus*; above which is situated the *lamina cornea*, that is, a thickening of the internal membrane of the ventricle (with the *vena striata*).

b. *Cornu anterius*. It extends from the lateral chamber before the clavate extremity of *corpus striatum*, forwards, downwards, and outwards, into the anterior lobe of the brain. The *anterior cornu* is bounded before by the *genu* of *corp. callosum*, internally by *septum pellucidum*.

c. *Cornu posterius* s. *cavitas digitata* passes from the posterior extremity of the lateral chamber into the posterior lobes of the brain, is externally convex, behind pointed, very insignificant, is situated near the *basis*, and presents on its inferior wall a gray projection [*Hippocampus minor*], which depends upon a convolution on the base of the brain, and is covered by white medullary striæ which give to it a digitate appearance (*pes hippocampi minor*), and pass on to blend with the *fornix*.

d. *Cornu descendens* s. *inferius*, extends in an arched form from the posterior extremity of *cella lateralis*, around the *optic thalamus* and *crus cerebri*, forwards and downwards into the middle cerebral lobe. Its superior concave wall is placed close upon the inferior convex, which forms the

Pes hippocampi major, cornu Ammonis. This is a cylindrical enlargement, thicker before and curved within, on the internal concave border of which a narrow thick edging, *tenia* (s. *fimbria*), and under that a gray, notched stripe, *fascia dentata*, is found. The external surface consists of whiter, the internal of gray, spiral, convoluted substance; the white passes on to the *corpus callosum* and *fornix*; the gray depends upon a convolution at the *basis* of the brain. (Compare *pes hippoc. minor*.)

2. The middle cerebral ventricle, *ventriculus tertius*, a narrow fissure in the middle line, above and behind broader, near the basis of the cerebrum, lying between the two *optic thalami* which form its lateral walls, and are covered with gray matter. Its floor is curved downwards; its posterior portion, white and strong, inclined forwards, corresponds to the space between the *crura cerebri*; its funnel-shaped centre, to the *corpp. mammillaria* and *infundibulum*; its anterior portion extends as far as to the posterior border of the *chiasma*.

Anterior wall, formed by *crura anter. fornicis*, before this *commissura anterior* and *lamina terminalis*, presents the *foram. Monroi*. The *posterior wall*, formed by *corpp. quadrigem.*, *commissura posterior*, presents under this the *aditus ad aqueductum Sylvii*. The roof is formed by *fornix* and *lyra*.

Openings :

1. *Foramen Monroi*, in front and above, leads into the right and left lateral ventricles.
2. *Aditus ad aquæductum Sylvii*, behind.
3. *Aditus ad infundibulum*, below, leads into the *infundibulum*.

Commissures :

1. *C. anterior*, a white cylindrical cord, passing *before* the *anterior crura* of the *fornix* from one hemisphere to the other. From it the *lamina terminalis* passes vertically downwards to the *chiasma*.
2. *C. Posterior*, smaller than the last, in other respects like it, uniting the *two thalami*, lying before the *corpp. quadrigemina*, under the pineal gland with which it is united.
3. *C. mollis*, a gray band stretched like a bridge between the anterior extremities of the *thalami*, passes transversely through the centre, nearer to the roof than to the floor of the cerebral ventricles.
3. The Aqueduct of Sylvius [*iter à tertio ad quartum ventriculum*], a three-sided canal, passes from the posterior extremity of the third ventricle, backwards and downwards, under the pineal gland [its commissure and the posterior commissure] and the *corpp. quadrigemina*, above the centre of the *crura cerebri* to the fourth ventricle.
4. The fourth ventricle, *ventriculus quartus* s. *cerebelli*, a rhomboidal space between the *cerebellum* and the *isthmus*, the former of which forms the posterior wall (roof), the latter (the floor). It is broad in the centre, in front narrow, and it passes backwards into a point. The *floor*, that is, above, the posterior surface of the *pons Varolii*, below, that of the *medulla oblong.*, is rhomboidal, and bounded laterally, below, by *corpp. restiformia*. The roof consists above of the *crura cerebelli superiora* and *valvula magna*, in the centre of the *vermis inferior*; below, of a fibrous plate from the neurilemma of the spinal marrow. The *superior* angle receives, below, the *valvula magna* of *aquæductus Sylvii*; the *lateral* angle reaches to the *corpus rhomboid.* of the *cerebellum*; the *inferior* angle presents a fissure between *medulla oblongata* and *cerebrum*, through which the fluid in the fourth ventricle communicates with that beneath the *arachnoidea* of the spinal cord. The *interior* is smooth, covered with a serous membrane, and contains, like the other cerebral ventricles, a *plexus choroideus*.

The Parts of the Cerebellum.

621.

I. On the hemispheres.

1. The superior lobes. They are, an anterior layer, and a posterior crescentic ; both are separated by the *sulcus horizontalis* from

2. The inferior lobes. These exist in greater number according as they are arbitrarily divided. We usually distinguish an anterior (*lob. biventer*), posterior, middle lobes, and

a. *Tonsilla* (s. *lobus medullæ oblongatæ*) ; lying, generally, internally in a depression on the anterior and middle lobes, behind and close to the *corp. restiforme* of its side, surrounding with its internal concave surface the *medull. oblongata*, and extending, with its anterior extremity inwards, into the fourth ventricle.

b. *Flocculus* (*lobul. nervi pneumo-gastrici*), placed behind the *crus cerebelli ad pontem* and *N. vagus*, below *Nn. facialis* and *acousticus*, before the *tonsilla*.

3. The medullary body of the hemispheres. In the interior of each hemisphere we find a white nucleus, from which fifteen to sixteen principal branches pass off, which again ramify, are surrounded by a brown substance, and thus produce the *arbor vitæ*. From the central point of the vertical, olive-shaped nucleus, *corpus rhomboideum* s. *ciliare*, the indented surface of which is formed of yellow and gray substance, pass out—

4. The *crura cerebelli*, of which there are three upon either side.

a. *C. cerebelli superiora* (s. *ad corp. quadrigem.*, *ad testes*), are placed before the *superior vermis*, pass, united, through *valv. Vieussens.*, converging upwards and forwards under the *corpp. quadrigem.*, to the cerebrum.

b. *C. cerebelli inferiora* s. *corpp. restiformia*, pass from the *medull. oblong.* (which see), forwards and upwards, to the hemispheres of the *cerebellum*.

c. *C. cerebelli lateralia* s. *ad pontem*. They are situated before the two preceding, at the anterior circumference of the *cerebellum*, and pass over internally into the *pons Varolii*.

622.

II. The Vermiform processes, *Vermis*,

is the central portion of the *cerebellum*, divided by the *sulcus horizontalis* into a superior and inferior portion, contains, likewise, in its interior, a medullary nucleus, from which medullary striæ pass into its two divisions.

1. The superior vermiform process, *vermis superior*, projects in

the middle line on the superior surface of the *cerebellum*, like a crest, and presents :

- a. *Mons cerebelli*, that is to say, the largest portion of the *vermis superior* ; its summit (*cacumen*) is situated rather in front, under the *splenium corp. callosi* ; behind (*declive*) and at the sides it is sloping.
- b. *Lobulus centralis*, the smallest part, is placed in the anterior excavation of the *cerebellum*, behind the *corpp. quadrigemina*, below the *mons*, above the anterior valve.
- c. *Folium cacuminis*, is placed in the posterior excavation, transversely behind the *mons*, and unites the two posterior lobes of the *hemisph. cerebelli*.

2. The inferior vermiform process, *vermis inferior*, lies, curled up like a worm, in the longitudinal fossa (*vallecula*) between the inferior lobes of *hemisph. cerebelli*, into which it passes, like the *vermis superior* ; behind and above *pons* and *medull. oblongata*. Four prolongations pass off from it (branches) :

- a. An *anterior*, the apex, in the anterior excavation, enlarged and clavate anteriorly (this is, *nodulus Melacarne*) ; it projects into the fourth ventricle.
- b. Two lateral, passing from a longitudinal uvula (*uvula vermis*) in the central line, and the broadest and highest part of the *inferior vermis*, lying before it (*pyramis vermis*), into the lateral angle of the fourth ventricle.
- c. A posterior (*tuber valvulæ*) is situated in the posterior excavation, and unites the posterior inferior lobes of the *hemisph. cerebelli*.

3. The great valve, *valvula magna cerebri*, s. *Vieussenii*, s. *velum medull. anterius*, a thin, semi-transparent, gray plate, spread out between the two *crura cerebelli superiora*. The anterior convex surface forms the posterior wall of *aquæductus Sylvii* ; the posterior concave looks towards the *vermis superior* ; the anterior border is connected with the posterior *corpp. quadrigemina* ; the posterior border with the medullary substance of the *vermis inferior*, above the *nodulus Melacarne*.

4. The small posterior valve, *velum semilunare* s. *medullare posterius*, a thin medullary plate, situated between *medulla oblong.* and *vermis inferior*, the short central portion turned freely towards the fourth ventricle, whilst the convex external border is attached from the *flocculus* as far as the *corpp. quadrigemina*.

623. *The Structure of the Brain.*

The gray centre of the *medulla spinalis* continues into the

medulla oblongata, enclosing a canal in its interior, which passes into the longitudinal sulcus of the *sinus rhomb.*, in consequence of which this fossa becomes covered with the gray substance (*stratum cinereum*). In some places it is more particularly collected together (*alæ cinereæ* and *subst. ferruginosa*). The anterior *crura* of the gray substance of the *medulla spinalis* form the (denticulated) nuclei of the olivary bodies (*corpp. denticulata*), and are surrounded by white substance, the posterior, in like manner, the nucleus of the *corpora restiformia*. The white fibres of the spinal cord everywhere surround the gray substance in the prolongations, form the pyramids and the so-called *eminentie teretes* of the *sinus rhomb.*, and cross each other in several places (Decussation). They then proceed into the *pons*, *crura cerebri*, the *cerebellum*, and so forth.

The *pedunculi cerebelli*, passing off from the cord-shaped bodies of the *med. oblong.*, form with their white mass the medullary centre (*meditullium album*) of the *cerebellum*, which (except in the *vermis*) encloses, as in the olivary body, a gray denticulated nucleus, and divides externally into lobes, which are again overlaid with gray substance, whereby arises the *arbor medullaris* or *arbor vitæ* (see before). The separate lobes and lobules are, as also in the *cerebrum*, united together by means of arched fibres, the so-called *massa explementi* which fill the intervals between them. The *pons* consists of two transverse and two longitudinal layers of fibres, between which the gray substance is deposited. The *pedunculi cerebelli superioris* s. *ad corpp. quadrigemina* pass away inwards under this (surrounded upon both sides by the *laqueus* which passes into the *corp. quadrigem.*), and strengthen the peduncles of the *cerebrum*. *Hypophysis cerebri*, and particularly *tuber cinereum* and *infundibulum*, consist almost entirely of gray substance, the nucleus of the *medulla spinalis* appearing in view. The *infundibulum* has a hollow in it. The peduncles of the *cerebrum* are continuations of the fibres from the *medulla oblongata* (from the pyramids, *funiculi siliquæ* of Burdach) and *cerebellum*. They consist of three fasciculi: *basis*, covering (*tegumentum*), and cord (*laqueus*), which are separated by black substance (which passes upon them into the three cerebral ganglia). The inferior layer passes into the *corpp. striata*, the superior or *tegumentum* into the *optic thalami*, the *laquei* into the *corp. quadrigem.*, the white mass of which they form. The four tubercles have each four gray nuclei. The *glandula pinealis* attached to them has a granular structure like that of the *pituitaria*, and consists of a grayish-red substance. The optic

tubercles have in the interior three distinct gray nuclei, one internal, external, and superior. The commissure (central) uniting the optic tubercles, as well as the border found between them in the third ventricle, also consists of gray substance. Still more distinct and larger are the three gray nuclei of the *striated bodies*, *nucleus caudatus lenticularis* and *tæniæformis*. The *stria cornea* consists of medullary matter, and only appears yellow when looking through a vein. From the cerebral tubercles the great medullary striæ, only, pass out, the *radiatio medullaris*, fibres, which, as they decussate with those of the *corp. callosum*, form the hemispheres of the *cerebrum*. From the *corp. striatum* fibres spread out towards both sides; in front and behind fasciculi of fibres go into the *fornix*, which they call the *forceps*. Those which cover the lateral ventricles are called *tapetum*. The anterior commissure consists, also, of white and gray matter. The *corpp. albicantia* (with gray nucleus) are the commencements [?] of the *fornix*; they pass, as *radix ascendens*, into the *columella fornicis*. Each right and left gives off a medullary plate, the *septum pellucidum*, between which is the *ventriculus septi pellucidi*, communicating with the third ventricle. The *columellæ* pass into the body of the *fornix*. This divides into the *crura*, and passes into the lateral ventricles. The peripheral part of the *fornix* passes in an arch around the *corp. callosum* (*gyrus fornicatus*), and terminates as, *uncus*, the hook. The fibres of the *crura* form in the cornua of the ventricles, with others of the *corp. callosum*, the *pæ hippocampi major* and *minor*. The first has two layers of medullary and two layers of gray substance; on it, as in the small, the gray is the cortical substance, covered by medullary fibres. The *fibræ explementoriæ* here also fill up the intervals between the fibres of the *radiatio medullaris cerebri* of the peripheral *fornix* and of the *corpus callosum*. Medullary laminæ do not only pass from one convolution to another in an arched manner, but a distinct mass also unites the anterior and inferior lobes in the *fossa Sylvii* (*fasciculus uneiformis*. Reil.)

624. *The Membranes of the Brain.*

The brain and spinal cord are enveloped by three membranes which pass, immediately, into one another at the *foramen magnum*. Those of the spinal cord, see § 628. The membranes of the brain :—

1. The *dura mater*, s. *meninx fibrosa*, a fibrous sac, the external rough surface of which is firmly attached to the internal cranial bones, and here serves as *periosteum*; the internal, smooth, and

moist surface is inseparably connected, by means of uniting tissue, with the *arachnoid*. It is connected externally with the external periosteum at the *foramina* of the skull, through which the nerves pass out, and forms prolongations internally which enter into the fissures of the brain. These are :

- a. *Falx cerebri*, passing from the *foramen cæcum* and *crista galli*, at first narrow, then broader, in the centre of the cranial vault from before backwards, where its base falls vertically upon the *tentorium*. The superior convex border reaches from *for. cæcum* as far as *protuberant. occipitalis*, and contains the *sinus longitudinalis superior*; the inferior concave touches the *corp. callosum* behind only, and contains a small vein (*sinus longitud. inferior*); the lateral surfaces separate the hemispheres of the cerebrum from one another.
- b. *Tentorium cerebelli*, a septum, placed transversely, is situated beneath the posterior lobes of the *cerebrum* and above the *cerebellum*; is maintained in mutual tension with the *falx cerebri*. The external larger circumference attaches behind to the *lineæ transvers.*, in front to the superior angle of the *petrous* bone, and contains the *sinus transversus*. Its internal smaller boundary is concave, and encircles the *pons Varolii* and *corpp. quadrigemina*. The *apices* of the external circumference are attached to the *proc. clinoid. posterr.*, those of the internal to *proc. clinoid. anteriorr.*, as they pass away under the former (decussating), and bound the *fossa pituitaria*. The *sin. cavernosi* are placed inside them.
- c. *Falx cerebelli* passes downwards from the *protuberantia occipitalis interna*, vertically, to the centre of the posterior circumference of *foramen magnum*, where it divides into two folds for the lateral parts of the foramen. The *basis* is in contact with the *tentorium*; the posterior border attaches itself to *crista occipital. poster.* The *anterior* looks towards the base of the posterior fissure, the lateral surfaces towards the inner surfaces of the posterior lobes of the *cerebellum*.

Structure. The *dura mater* consists of two fibrous layers, which in several places separate from one another, and form triangular canals for the reception of veins: these are the *sinus*. The fibres of the layers decussate in various directions. Between the internal layer and that of the *arachnoid*, along the *longitudinal sinus*, we find in the adult the white *corpp. (glandul.) Pacchioni*, which often project into the *sinus*, and produce thinning of the cranial bones.

625. Sinus venosi duræ matris. They consist of the internal coat of the vessels, strengthened by fibres of the *dura mater*, and they have small valves. The *sinus* of either side are in communication, by means of transverse *sinus*, with those of the other side, and by *venæ diploicæ* and *emissaria Santorini* with the external cranial veins. They empty their blood into the *V. cephalica* (s. *jugular.*) *interna*.

Venæ diploicæ are situated between the two tables of the bones of the skull in the diploe, and enter into communication, internally, with the *sinus* of the cranial cavity, externally with the external veins of the head. In each half of the skull four large branches are found :

1. *Frontalis* passes through a small foramen at the *incis. supraorbit.* to the *V. supraorbit.*

2. *Temporalis anterior* passes from *angul. parietal. anter.* to *V. temporalis*.

3. *Temporalis posterior* passes behind and above *proc. mastoid.* outwards, or opens into *sin. transversus*.

4. *Occipitalis*, the largest, opens, in the neighbourhood of the middle line on the *linea semicircul. infer.*, into the *V. occipitalis*.

Emissaria Santorini are canals which connect the *sinus* with the external veins, through peculiar foramina in the cranial cavity. The largest passes through *foram. mastoid.*, *parietale*, and *condyloid. posterius*.

The *sinuses* which meet together in the *torcular Herophili* :

1. *Sinus longitudinalis superior*, is situated in the superior border of the *falx cerebri*, receives on either side seven to ten *Vv. cerebri superr.* from the surface of the brain, and some smaller from the *falx major*, is connected by means of *foram. parietale* with *Vv. occipitales*, by means of *for. cæcum* (in children), with the nasal veins, and falls from above into the *torcular*.

2. *Sinus tentorii medius* s. *quartus*, lies at the basis of *falx cerebri* above the centre of the *tentorium*, from before to behind, where it opens into the anterior boundary of *torcular*. It forms the continuation of the *V. magna Galeni*, which arises from the two *Vv. cerebri interni*, and receives at the anterior part the

3. *Sinus* s. *V. longitudinalis inferior*. It passes along the inferior concave border of *falx cerebri*, is narrow, and sometimes absent.

4. *Sinus transversus* s. *laterales*, a right (usually wider) and a left, passing off laterally from *torcular*, and passing in the *sulcus transversus*, at first on the posterior border of the *tentorium*, horizontally, then in the *fossa sigmoidea* downwards, inwards, and

forwards to *foram. jugulare*, and passes into the *bulbus ven. jugularis*. They are connected by means of an *emissarium Sant.* in the *foram. mastoid.* with *Vv. occipital. superficiales*, and receive, besides the veins of the *posterior cerebral lobes, cerebellum* and internal ear, the *sinus petrosus superior*, and partly the *occipitalis posterior*.

5. *Sinus petrosus superior*, passes along the superior angle of the *petrous* bone in the *tentorium*, connected at the apex with *sin. cavern.*, and opens behind and externally in *sin. transvers.*

6. *Sinus occipitalis posterior*, descends singly or double from the inferior circumference of the *torcular*, in the *falx cerebelli* to the posterior border of *foram. magnum*, opening right and left into the *sin. transvers.*, and into *plexus venos. spinalis*.

Torcular Herophili s. confluens sinuum, is the expanded point before the *protuberantia occipitalis interna*, where the above-mentioned *sinus* meet together with five (or six) orifices.

Sinus which meet together in the *confluens sinuum anterior*, between the apex of the *petrous* bone and the *sphenoid* of either side:

7. *Sinus petrosus inferior*, passes in the groove between the internal inferior border of *os petros.* and the *pars basilar. oss. occipitis*, between *foram. lacerum posticum* and *anticum*, connected in front with *sin. cavernos.* and *occipital. anter.*, opening under *sin. transvers.* at the anterior circumference in the *V. cephalica interna*. It unites the anterior and posterior *sinus* of the *basis cranii*.

8. *Sinus occipitalis anterior (transversus) s. basilaris*, a transverse venous plexus lying upon the *clivus*, uniting the *sin. petros. infer.*, as also the *sinus cavernosi* of the right and left side with each other.

9. *Sinus cavernosus*, situated at the sides of the *sella Turcica*, between the apex of the *petrous* bone and the *fissura sphenoidalis*, is wide and cellular by means of numerous fibrous bands, is perforated by *carotis interna*, *plexus caroticus* and *N. abducens*, and has on the external wall the *N. oculo-motorius*.

At the anterior external extremity (*sinus ophthalmicus*) it receives the *Vv. ophthalmicæ, V. fossæ Sylvii* connected with that of the other side below the *hypophysis* by means of *sinus circularis inferior*, by means of *foram. lacerum anterius* with *plexus pterygoid.*, and opens behind into the *sinus petrosi*. Into it open:

10. *Sinus circularis Ridleyi*, which surrounds the pituitary gland in the *sella turcica*.

11. *Sinus sphenoparietalis s. alæ parvæ*, lies on the lateral

wall of the cranial cavity, between the anterior and middle fossæ, uniting with *V. meningeæ media*; it receives the anterior *diploica temporal.*, and opens into the *sinus cavernosus (ophthalmicus)*.

The vessels and nerves of the *dura mater*.—*Arteries: meningeæ anterior.*, from *ethmoidalis*; *media*, from *maxillaris interna*; *posteriores*, from *pharyngea ascendens*, *occipitalis* and *vertebralis*.

Veins: Vv. meningeæ, double for each artery, open into the *sinus* and into *plexus pterygoideus*. Lymphatics are wanting (Arnold); those on the internal wall belong to the *arachnoidea*. Nerves: branches from the first division of *trigeminus* and *trochlearis*, two long branches near the middle line.

2. *Arachnoidea* (the serous membrane). The external surface of the *pia mater* is covered with pavement epithelium, which extends over the convolutions of the brain like a bridge, passes upon the internal surface of the *dura mater*, firmly attached to it by uniting tissue, and thus forms a closed sac, which does not enter the cerebral cavities, lies between *pia* and *dura mater*, and contains in its cavity, even during life, a serous fluid (*fluidum cerebro-spinale*) which may be pressed out in drops, or in a jet, after piercing it.

3. *Pia mater s. meninx vasculosa*, the soft, vascular envelope, a thin membrane formed of a vascular rete, and uniting tissue, lies close upon the surface of the brain, surrounded by the internal layer of the *arachnoidea*; enters the sulci and ventricles, and forms

The *plexus choroidei*, which folded in a curly form are situated, one in each ventricle, but continue uninterruptedly into one another, and send numerous blood-vessels into the substance of the brain. They are covered with epithelium, which is distinguishable from the ciliated epithelium of the ventricles.

626.

Vessels of the Brain.

The brain is largely supplied with blood, the course of which is retarded by the convolutions of the arteries. These quickly ramify on the surface, and penetrate thus into the cortical substance: other branches pass into the cavities, form the *plexus choroidei*, and supply from this point the medullary substance.

There are the two *carotides internæ* and *vertebrales*.

The *cerebrum* is supplied by branches from *both*, the *cerebellum* from those of the vertebral alone; namely:

a. The *cerebrum* by: *art. corporis callosi* and its two *Rr. com-*

municantes, art. *fossæ Sylvii*, *choroidea* and *profunda cerebri*.

- b. The *cerebellum* by: artt. *cerebelli inferior*, *media* and *superior*.

Veins do not accompany the arteries; they are found plentifully on the surface, and fall into the *sinus* of the *dura mater*.

- a. In the interior of the *cerebrum* pass:

1. *V. choroidea*, arising at the anterior point of *cornu descend.* of the lateral ventricle; it ascends in the *plexus choroid.*, the veins of which, as well as those of the *cornu Ammonis*, it receives and unites with.
2. *V. corporis striati*, which passes from the *stria cornea* between *corp. striatum* and *thalam. n. optici*, whilst still in the lateral ventricle, to
3. *V. cerebri interna s. magna*. This enters into the third ventricle through *foram. Monroi*, passes into its *plexus choroid.* from before backwards, unites between *corp. callos.* and *quadrigem.* with that of the other side into a short (two to three lines thick) trunk, the *vena Galeni*, which, at the junction of *tentorium* and *falx cerebri*, enters into the last and the *sinus quartus*.

b. The veins of the *cerebellum* open into the *Vv. vertebrales*, into the *sinus transvers.*, *petrosi* and *occipitalis posterior*.

627. The Spinal Marrow, *Medulla spinalis*, μυελὸς, ἑαχίτης.

This is the medullary column, flattened from before backwards, which passes downwards into the *canalis spinalis* as the immediate continuation of the *medulla oblongata*, surrounded, like the brain, by membranes. Its surface is white. Its length measures, in the adult from fifteen to eighteen inches; its circumference, at the inferior extremity of the *cervical* portion = eighteen lines, in the *lumbar* portion = twelve (*intumescencia cervicalis* and *lumbalis*), whilst the *dorsal* portion is the smallest, on which account the nerves arising from it are also the smallest. Its *superior* extremity passes uninterruptedly into the *medulla oblongata* at the *foramen magnum*; its *inferior* termination, on account of the long lumbar and sacral nerves, which lying close together, are called *cauda equina*, reaches, in the fœtus, as far as the *sacrum*, in the adult to the second lumbar vertebra, where it terminates in a conical form (*conus medullaris*) and presents two ganglia, as an exception, only. On its anterior and posterior surfaces a fissure is observable in the middle line (*fissura mediana*); at the base of the anterior fissure a

transverse porous *commissura alba*, but upon that of the deeper posterior fissure, gray substance (*comm. grisea*) which is situated in the interior of the spinal marrow. This posterior fissure is, according to Arnold and Valentin, in the fresh medulla, merely a groove which only above and below passes into a fissure. We may regard the spinal cord as consisting of two lateral halves. Each half is divided by a *sulcus lateralis* (for the posterior roots of the spinal nerves) into a larger *anterior* and a smaller *posterior* column, between which and the anterior roots of the spinal nerves, even a yet smaller, central, may be detected. In the commencement of foetal life a canal is found in each half.

Structure of the Spinal cord. White substance forms the exterior, *cortex*, of the spinal cord, and gray the *nucleus*.

The *gray* substance consists of ganglion globules (see before). It is very vascular, of various colours (darker in children), and presents, upon a transverse section, generally, this figure)(, above and below rather *v-shaped*; hence in the gray substance a centre and cornua, or crura, are described. The cornua are directed outwards towards the roots of the spinal nerves, lying, however, closer to the posterior surface.

The medullary substance consists of longitudinal fibres (nerve tubules) which pass close to, but independently of, one another, are separated by sheaths (*pia mater*), at least the larger, from each other, forming broader or narrower fasciculi, and at last the two (three) columns of either side, observable externally. According to Valentin, the fibres are the immediate continuations of the spinal nerves, which pass upwards, and the medullary substance contains no more fibres than those taken together. Free extremities are not found. Above (see Medull. Oblong. § 618.) the posterior columns, divided into three to four fasciculi, go forwards, obliquely through the gray substance, and proceed onwards as the anterior pyramids, since the fasciculi of the two sides decussate (*decussatio*), whilst the anterior columns pass directly into the posterior pyramids (*corpp. restiform.*)

628. The *membranes* of the *spinal cord*, the immediate continuations of the cerebral membranes.

1. *Dura mater*, a long fibrous cylinder, extending from *foram. magn.* to the termination of *canal. sacralis*. The *external* surface is separated from the vertebral canal by means of uniting and adipose tissue, in which the *plexus venosi spinales (interni)* is found. It does not perform the office of periosteum to the vertebræ. The *internal* surface is covered with the *arachnoid*, and connected in

many places with the *pia mater*. Behind it is free; before it is connected by processes with *lig. longitudinale posterius*. Laterally, sheaths pass off with the nerves through the *foramina intervertebralia*, for the posterior and anterior roots of which there are openings (two) in it. The superior extremity is firmly attached to the circumference of the *foram. magnum*, and passes into the *dura mater* of the brain; the *artt. vertebrales* perforate it at this point. The inferior extremity forms a wide sac around the *cauda equina*, divides into several sheaths (from five to six) for the sacral nerves, and is firmly connected with *lig. sacro-coccyg. postic.* Vessels: arteries are *rami spinales*, the *artt. cervicales*, *dorsales*, *lumbales* and *sacrales*. The veins pass into the *plex. spinales interni*. Nerves have not yet been found, the *dura mater* is however sensitive.

2. *Arachnoidea*. Between the *dura* and *pia mater* an epithelium layer is placed, as in the brain, which covers the uniting tissue of the two surfaces, opposed to each other, and is regarded as a proper tunic; that is, the *arachnoid* membrane. It envelops the nerves of the *cauda* only, as far as the *foramm. intervertebr.*, and is then reflected upon the *dura mater*. Between *dura* and *pia mater* a space is also found, filled with cerebro-spinal fluid, which facilitates the movement of the spinal cord.

3. *Pia mater*, is stronger than that of the brain, dirty white, sometimes, in the cervical region, dotted with blackish spots. It forms the neurilemma of the *medulla spinalis*, to which it is firmly applied, into the fissures of which it enters, and envelops the *nervous fasciculi*. It is strengthened by fasciculi of fibres, which are only lost in the cranial cavity; it is formed besides of uniting tissue and *vascular rete*. On either side the thin edge of the fibrous *lig. denticulatum* is attached, from the free, thicker edge of which (from twenty to twenty-one) denticulations pass outwards, and connect themselves with the *dura mater* in the intervals between the anterior and posterior roots of the nerves. The first denticulation is placed in the *foram. magn.* between *art. vertebral.* and *n. hypogloss.*; the last at the first lumbar vertebra. From this point, the inferior extremity of *conus medullaris*, the *pia mater* terminates in a delicate thread, *filum terminale*, which above, only, contains a little gray medullary matter, and is attached below in the sacral canal to the termination of the *dura mater*.

The Peripheral portion of the Nervous System.

629. A. The cerebral nerves, *nervi cerebrales*.

There are twelve pairs, of which the first, second, and eighth

are destined for the organs of the senses entirely, the third and seventh pass forth between the anterior and middle, the ninth and twelfth between the middle and posterior cranial vertebræ.

630. I. *N. olfactorius*, the nerve of Smell.

Origin: from the basis of the anterior cerebral lobe with three white roots; the *external*, longest, passes in a curve from the *fossa Sylvii* inwards and forwards; the *middle*, short, directly forwards, and the *internal* rather curved inwards, arises from the *substantia perforata anterior*. Each root consists of several smaller. They are united into a three-sided nerve (*tractus olfact.*) which runs in a sulcus on the inner side of the inferior surface of the anterior cerebral lobes, is soft, striped with gray, and surrounded by the *pia mater*. It lies upon the cribriform plate, and terminates with the:

Bulbus cinereus, a club-shaped, flat enlargement, three lines long, and usually of gray substance. This olfactory bulb is, in young embryos and in the lower animals, hollow, and connected with the lateral ventricles. From its inferior surface many delicate *nn. olfactorii*, covered by *dura mater*, pass downwards through the foramina of the cribriform plate in two rows.

The *external* row (from twelve to sixteen nerves) spreads out in a rete upon the mucous membrane of the two superior nasal conchæ.

The *internal* row (from nine to twelve nerves) expands in tufts upon the mucous membrane of the septum of the nasal cavity, in the centre almost to its floor.

631. II. *N. opticus*, the nerve of Sight.

Origin: from *thalamus opticus*, the posterior mass of which passes into the optic tracts, *corpp. geniculata* and *quadrigemina*. Course: 1. As *tractus opticus* (which see). 2. As *chiasma n. optic.* (which see). 3. From the *chiasma* the *n. opticus*, even now covered by the *dura mater*, passes forwards and outwards, through *foram. opticum* into the orbit and to the globe of the eye, the coats of which it perforates behind, rather internal to its axis, and expands as the *retina* (which see). In the *foram. opticum* it lies above and internal to *art. ophthalmica*; in the *orbita*, surrounded by the four *mm. recti*, and much fat; *ganglion ophthalm.*, *nervi et vasa ciliares* lie close to it. Its sheath (of the *dura mater*) passes from the *foramen opticum* into the *sclerotica*. It nowhere divides into filaments, but has in its centre a deficiency (*porus*) for the *vasa centralia iridis*.

632. III. *N. oculo-motorius*, the nerve of Motion for the muscles moving the globe of the Eye.

Origin : between the *crura cerebri*, and from them, with a series of filaments, the most internal meeting in the *subst. perforata media* (therefore the simultaneous movement of both pupils, see *gangl. ophthalm.*), it passes forth between *pons Varolii* and *corpp. mammillaria*. Course: at the commencement flat, between *art. cerebri poster.* and *cerebelli superior*, then round the last upwards, outwards and forwards as far as *sella turcica*, where it perforates the *dura mater* and the *sinus cavernos.*, and passes at the most internal part through *fissura orbitalis superior* into the orbit. Before that it divides into a *ram. superior* and *inferior*, which separate in the *orbita* and unite (not always) with *plexus caroticus*. Situation in the *cavernous sinus*: external to *carotis*, above *n. abducens*, internal to *n. patheticus* and *ophthalmicus*; immediately in the orbits, below *n. frontalis* and *patheticus*, internal to *ram. nasalis*.

1. *Ramus superior*, below and for *m. rectus super.*, and for *lev. palpebr. super.*, in which it soon ramifies with many branches.

2. *Ramus inferior*, much larger, between *n. opticus* and *abducens*, internal to *m. rect. externus*; it immediately divides into three branches:

- a. *Ram. internus*, to the internal surface of *m. rect. internus*.
- b. *Ram. inferior*, to *m. rect. inferior*.
- c. *Ram. externus*, passes on the outer border of *m. rectus inferior* to *m. obliq. inferior*, and gives off the short root of *gangl. ciliare*.

N. oculo-motor is the motor nerve for all the muscles of the globe of the eye, with the exception of *m. obliquus superior* and *rectus externus*.

633. IV. *N. Trochlearis* s. *patheticus*.

Origin : with three to four filaments from *valvula cerebelli anterior* s. *magna*, between the *cerebrum* and *cerebellum*, behind the *corpp. quadrigemm.*; it inclines round the *crus cerebelli super.* and appears at the basis before the *pons Varolii*, external to *crus cerebelli*, internal to *n. trigeminus*. Course: forwards through a canal of the *tentorium* to the outer wall of the *sinus cavernosus*; passes through the broadest part of the *fissura orbit. super.*, at the same time with *ram. frontalis*, into the orbits. Here it passes inwards and forwards, obliquely over the *ram. super. n. oculo-motor.*, and the posterior extremity of *mm. levator.* and *rectus sup.*, to the superior border of *m. obliquus superior*. Situation : as far as *sella*

turcica, between *pia mater* and *arachnoid*, below the *oculo-motorius*; in the *sinus cavernosus*, on the outer side of the last nerve, above *n. ophthalm.*, united with it by means of several filaments; in the orbits, close under the *periorbita*, internal to *ram. frontalis*, where it gives off filaments to the *ram. lacrymalis*. Branches: *ram. tentorii*, from out of the *sinus cavernosus* backwards to *sin. transversus*; it comes, according to Arnold, from *ophthalmicus*.

N. trochlearis, long and thin, supplies the *obliquus superior*, is the *n. respiratorius oculi*, according to Sir C. Bell.

634. V. *N. trigeminus* s. *quintus*, the Trifacial nerve.

Origin: with two roots; the larger *posterior* (ganglion) root, from *corp. restiforme* (continuation of the posterior columns of the spinal cord); the *anterior*, smaller root from the surface of the *pons*, in the anterior lateral part of which, both (the small root from within) become visible in a fissure, as they are united into a trunk. Course: the trunk passes from the *pons* as a flat fasciculus upwards, outwards and forwards, through a canal which the *dura mater* forms with the superior border of the apex of the petrous bone. Here the fibres of the *posterior* root (*portio major*) separate and interlace, and form alone the *ganglion Casseri*, whilst the anterior root (*portio minor*) passes away under the posterior surface of the ganglion, and with the third branch of the *ganglion* forms the *n. maxillaris inferior*. [The two portions of this nerve are generally separated at their exit from *pons Varolii* by a few of its fibres.]

Ganglion Casseri, the semilunar ganglion, consists of soft gray substance traversed by white fibres; it is flat, convex in front and externally, lies on the anterior surface of the apex of the petrous bone, in a depression, firmly united with the *dura mater*. The three following branches pass off from its convexity:

Ramus ophthalmicus.

Ram. maxillaris superior, and

Ram. maxillaris inferior.

They diverge as they pass out, and the last is accompanied by the small (motor) root of the *n. trigeminus*. From the *Cass. ganglion* a few fibres pass to the *tentorium* and to the *dura mater* of the petrous and sphenoid bone; others to the *plexus caroticus*.

635. *Ramus I. trigemini* s. *N. ophthalmicus*,

the smallest and most superior of the three branches of *gangl. Casseri*, passes forwards, outwards and upwards, on the outer wall

of *sinus cavernosus*, gives a filament backwards which accompanies another of the *trochlearis* to the *tentorium*, and divides into three branches, which pass through the *fissura orbitalis superior*, at different points, into the *orbita*. Position: below *n. trochlearis*, external to *n. oculo-motorius* and *abducens*. Branches from without inwards are: *N. lacrymalis*, *n. frontalis*, *n. nasalis*.

1. *N. frontalis*, the frontal nerve, the continuation of *ophthalmicus*, and its thickest branch, passes horizontally forwards under the *periorbita* and obliquely above the *lev. palpebr.*, sends frequently a small branch which passes over the *m. obliq. sup.*, and under the *trochlea*, out of the *orbita*, and into the superior eyelid. In front it divides into:

- a. *N. supraorbitalis*, the external larger branch, which passes through *foram. supraorbitale*, out of the *orbita*, sends numerous branches *downwards* to the superior lids (one of which anastomoses with *n. facialis* beneath *n. orbicularis*), two others *upwards* to the skin of the forehead, which may be followed as far as the lambdoidal suture, but only supply the skin and periosteum. A smaller branch passes through a small foramen in the *foram. supraorbit.* into a canal on the frontal bone, and to the skin of the forehead on the *tuber frontale*.
- b. *N. supratrochlearis*, the smaller internal branch, passes out between *for. supraorbit.* and (above) the *trochlea* of *m. obliq. sup.*, and divides into *superior* branches for the top of the forehead, and into *inferior* for the upper lid and back of the nose, where it anastomoses with *n. nasalis*. Sometimes two *nn. supratrochl.* are present.

2. *N. nasalis* s. *naso-ciliaris* passes between *ram. super.* and *infer.* of *oculo-motor.*, inwards and forwards, obliquely over *n. opticus*, beneath *m. rectus* and *obliq. super.* to the internal wall of the *orbita*, and divides at the superior border of *m. rectus intern.* into *n. ethmoidalis* and *infratrochlearis*. Before this one or several *nervi ciliares* pass off from it, and the

- a. *Radix longa ad ganglion ciliare*, a minute, sometimes double filament, which separates even in the cranial cavity (in the *sinus cavern.*), where also a grayish filament (*radix media*) from *plexus carot. n. sympath.* is applied, and accompanies it to the posterior angle of the

Ganglion ciliare s. *ophthalmicum*. This lenticular, flat, grayish-red ganglion lies in a considerable quantity of fat on the outer side of *n. opticus*, two to three lines distant from the optic foramen, beneath *art. ophthalmica*. The *radix brevis* from *oculo-motorius* enters at its posterior in-

ferior angle. From its anterior border two small fasciculi pass off the

Nervi ciliares. They pass along in a tortuous manner with *artt. ciliares*, anastomosing with one another; they perforate the *sclerotica* around the *n. opticus*, pass evenly between this and the *choroidea* to the ciliary ligament, and some, thence, to the *iris*, where they divide; others pass immediately to the *retina*. The superior fasciculus has four, the inferior five to six filaments.

b. *N. ethmoidalis* passes immediately through *foram. ethmoidale anterius* from the orbit into the cranial cavity, passes from behind forwards upon the superior surface of the cribriform plate of the ethmoid bone near the *crista galli*, and sinks into the nasal cavity through an anterior foramen, where it divides into an internal and external branch.

1. *Ramus interna* s. *septi mobilis*, upon the mucous membrane of the anterior part of the septum.

2. *Ramus externus* gives a branch to the conchæ and anterior part of the septum; passes into the sulcus of the nasal bone, and comes forth between the bones and cartilage, and ramifies upon the skin of the *ala nasi* as far as the point where it anastomoses with *n. facialis*.

c. *N. infratrochlearis* passes on under *m. obliquus superior* with *art. ophthalmica*, escapes from the orbit beneath the *trochlea*, and divides into:

1. *External* branches, which perforate the *m. orbicularis*, and at the free border of the superior lid anastomose in loops, supplying the lacrymal sac and caruncle.

2. *Internal* branches, which anastomose upon the root of the nose with branches of *n. facialis*.

3. *Superior* branches, which pass to the forehead, and anastomose with *n. supra-trochlearis*.

3. *N. lacrymalis*, the smallest branch of *ophthalmicus*, passes along the superior border of *m. rectus externus* on the outer wall of the orbita, with *art. lacrymalis*, and divides into an external and internal branch.

1. *Ramus externus* s. *nerv. zygomaticus* passes through the malar bone, uniting with *n. facialis* on the cheek.

2. *Ram. internus* passes through the lacrymal gland, ramifies in it, then perforates the upper lid with a branch which reaches as far as the *tarsus*, and with another which is lost in the skin of the anterior temporal region.

636. *Ramus II. trigemini s. N. maxillaris superior.*

The superior maxillary nerve, in point of size and position in the middle between *I.* and *III.*, passes, after a short course, through *foram. rotundum* into the *fossa sphe-no-maxillaris*, where branches pass off from it in all directions, accompanied by branches of *art. maxillaris interna*. It divides (Arnold) into three principal branches, which correspond to those of the *ophthalmicus*.

1. *N. subcutaneus malæ* corresponds to *n. lacrymalis*, enters the *orbita* through *fissura orbital. infer.*, passes along the inferior wall forwards, and divides into an ascending *ram. lacrymalis*, which enters the lacrymal gland from below, anastomoses with *n. lacrymal.*, and gives filaments to the external angle of the eye; and a horizontal *ram. malaris*, which passes along through the anterior malar foramen, with a filament for the skin of the cheek, with another (often double) to the anterior part of *m. temporalis*, and there anastomoses with *n. tempor. profund.* (See *maxillaris inferior*.) [A temporal branch also ascends, perforates the outer wall of the orbit, afterwards the temporal fascia, and supplies the skin about the external angular process of the frontal bone].

2. *N. sphe-no-palatinus* corresponds to *n. nasalis*, a shorter branch, descends vertically into the *fossa sphe-no-palatina*, and enlarges on the outer side of the foramen into the

Ganglion sphe-no-palatinum s. rhinicum s. Meckelii. This grayish-red, soft, three to four-cornered *nasal ganglion*, is larger than the *ophthalmic*, with which it is frequently in connexion by means of a filament (Tiedemann). It consists of two roots; the *short* consists of several filaments from *nerv. sphe-no-palatin.*; the long, *radix mollis*, that is *ram. profundus n. Vidiani*, comes from the *plexus caroticus n. sympathici*, is grayish-red, and under *n. Vidianus recurrens* in a sheath. Two or three filaments pass through *fiss. orbitalis infer.* into the *n. opticus*. Through it pass:

a. *Nn. palatini*, descending vertically. They are:

1. *Palatinus antierius s. major*, passing through the posterior palatine canal, at the inferior orifice of which it inclines forwards upon the palatine vault. Before that it gives off *ram. nasalis inferior*, for the middle nasal chamber and the inferior concha; farther, *several filaments*, which pass upon the internal walls of the *antrum Highmori* to the last molar teeth; lastly, a *ram. staphylinus* for the *uvula*. Its terminal branches pass on the alveolar

borders and in the central line to the glands, and the mucous membrane of the palate, and to the gums.

2. *Palatinus posterior s. medius* passes in a proper canal, and, having left it, backwards to the posterior nasal opening.

3. *Palatinus externus s. parvus*, for the palatine arches and tonsils.

b. *Nn. nasales posteriores*, very fine, pass inwards through the *for. spheno-palatinum* into the nasal cavity, advancing, when there, between the bones and mucous membrane on the outer wall and on the septum. They pass, contrary to the branches of the first division, in the vault, so that the proper nerves of smell are surrounded in a circular manner by these nerves of sensation, like the optic nerve by the *nn. ciliares*.

1. *N. naso-palatinus Scarpæ s. n. septi narium* passes inwards, before the *sinus sphenoidalis*, below its opening to the nasal septum, and on this almost horizontally forwards to the *canalis incisivus*, through which it passes to the mucous membrane of the mouth behind the incisor teeth, without anastomosing with that of the other side, and without forming a ganglion.

2. *Nn. nasales superiores*, three to four, pass vertically downwards on the posterior part of the outer wall of the nasal cavity, between the mucous membrane and periosteum, supplying the concha and nasal chambers, and the *pharynx* at the orifice of the *tuba Eustachii*, with a *ram. pharyngeus* (Bock).

3. *N. Vidianus s. petrosus superficialis s. recurrens* passes from the posterior part of *ganglion Meckelii* backwards, through the *canalis Vidianus*, enters between temporal and sphenoid bone, perforating the mass of cartilage in the *foram. lacerum anter.*, into the cranial cavity, and into a sulcus on the anterior surface of the petrous bone, through *hiatus canal. Fallopiæ* to the bend of *n. facialis*, with which it anastomoses. Below it, passes the *n. petrosus profundus*, a larger branch, and of a more gray hue, which lies in the *can. caroticus* on the outer side of *carotis*, and ascends to the *gangl. Meckelii* from the *plexus caroticus*, where it anastomoses with the branches which pass to the *nerv. oculo-motorius*.

3. *Nervus infraorbitalis*, the continuation of the trunk, corresponds to the *n. frontalis*, enters through *fissura orbital. infer.* into the *canalis infraorbitalis*, passes to its anterior orifice (above and

external to *art. infraorbit.*), where it divides into fibres on the face, and sends branches upwards :

- a. *Rami palpebrales*, to the skin, and under *m. orbicularis*, to the *conjunctiva* of the inferior eyelid ; internally :
- b. *Rami nasales*, to the skin of the *alæ nasi* ; downwards :
- c. *Rami labiales*, to the upper lip, for the skin and mucous membrane. These last are very numerous, and they anastomose particularly with *n. facialis*.

Before its entrance into the *canal. infraorbitalis* the trunk gives off:

1. *N. dentalis posterior superior* ; it often arises with two to three filaments (between which *art. alveolaris poster.*), descends forwards upon the *tuber maxillare*, gives branches to the *m. buccinator* [they most likely perforate this, and supply the mucous membrane], the fat of the cheek, and the gums. The superior branch penetrates, above *tuber maxillare*, the inferior below it, between the bony plates of the upper jaw, into the *canal. alveolar. poster.*, forms there a *plexus*, from which one filament passes off for each root of the molar teeth, and terminates in the dental pulp.

Inside the *canalis infraorbitalis* the trunk gives off:

2. *N. dentalis anterior superior*, arising half an inch behind *foram. infraorbitale*, is very large ; it passes vertically down in a canal between the bony plates of the upper jaw to a plane with the floor of the nose, and ramifies close to that into :
 - a. Ascending branches, which are lost in *spina nasalis anter.*, give a branch to the nasal mucous membrane and inferior concha ; and :
 - b. Descending branches, for the *first molar*, the *cuspidati*, and *incisor* teeth.

637. *Ramus III. n. trigemini* s. *N. maxillaris inferior*.

The inferior maxillary nerve is the largest and most posterior of *trigeminus*, consisting of a *posterior external* fasciculus, which comes from the *gangl. Casseri*, and an *anterior internal* fasciculus, that is, the small root (motor fibres) of *trigeminus*. Course : passes quickly out of the cranial cavity through *foramen ovale* into the *fossa zygomatica*, where it immediately divides into eight branches, of which the three first belong to the posterior, the five others to the anterior fasciculus.

1. *N. temporal. superficial. s. auricularis anterior.* The temporo-auricular nerve corresponds to the *lacrymalis* and *subcutaneus* of the first and second division. Origin: outside and behind the third division, with two roots, which surround the *art. meningea media*, and contain two filaments of *gangl. oticum*. Course: backwards and rather downwards behind the *collum condyli* of the lower jaw, where it divides into an ascending and descending branch.

- a. *Ram. temporalis* inclines backwards and upwards around *condylus*, between the articulation and external auditory meatus, perforates the *parotis*, and passes, in company with *art. temporal.*, into the temporal region close beneath the skin, in which it ramifies to the vertex. At the condyle it gives one (important), sometimes two,

ram. communicantes to *n. facialis*, farther branches to the temporo-maxillary articulation, to the skin of the *meatus auditor. extern.*, to the tympanic membrane; in the temporal region a connecting branch with *n. temporal. profund.*, and a plexus for *art. temporalis*.

- b. *Ram. auricularis* forms a plexus behind the *condylus* about the *art. maxillar. interna*, perforates the *parotis* with five to six branches which pass to the lobe of the ear; others anastomose with filaments of *plexus cervicalis*; one branch unites with *n. dentalis*; another enters the maxillary articulation.

Ganglion oticum (Arnoldi). This flat, oval *otic ganglion* is situated close under the *foram. ovale* on the inner side of *n. maxillar. infer.*, where the *portio minor trigemini* joins it closely; internal to the cartilaginous *tuba Eustachii* and the origin of *m. circumflexus palati mollis*, before *art. meningea media*. It has three roots:

1. The long one comes from *n. tympanicus* of *glosso-pharyngeus*.
2. The short from *portio minor* (especially of *pterygoid. internus*) of the *trigeminus*.
3. The central, soft, from the first cervical ganglion of *sympathicus*, the filaments of which pass along the *art. meningea media*. From it, constantly, arise, from the upper portion:
 1. *Nerv. ad tensorem tympani*, a soft, grayish-red filament, passing along by means of *tuba Eustachii* to the tensor of the tympanic membrane. Another nerve comes from *n. pterygoid. internus* to this muscle, which perforates the *otic ganglion*, and receives a little of its substance;

on this account the *memb. tympani* cannot be directly moved at the instigation of the will. Usually:

2. Two filaments to *n. auriculo temporalis*.
3. One filament to the *chorda tympani* (Krause), and one likewise to *m. circumflexus palati mollis* (Cruveilhier).

[The translator takes the liberty of adding, in this place, a paragraph from M. Longet's work (*Anat. et Phys. du Système Nerveux*, par F. A. Longet, 2 vols., Paris, 1842), vol. ii. p. 501:—"As for the ganglia which constitute the *cephalic* portion of the great sympathetic, I have myself often insisted upon the double connexion of each of them with a *motor* and *sensitive cerebral* nerve; and I have proved, against the opinion of Arnold, that the sphenopalatine ganglion does not form an exception, and that it likewise receives filaments from a cranial nerve which presides over movement. All these ganglia (*ophthalmic, sphenopalatine, otic, and sub-maxillary*) having been described with details suitable to the *trifacial* nerve, I have only to remind the reader that the common *motor oculi* or the *facial* nerve furnishes their *motor* roots, whilst the *glosso-pharyngeal* or the *trifacial* sends to each of them the *sensitive* roots."]

2. *N. alveolaris inferior*, descends at first between *m. pterygoideus extern.* and *internus*, then between *internus* and the *ramus* of the lower jaw, separated by an aponeurosis from *n. lingual* and *m. pteryg. intern.* through *foram. alveolare poster.* in the canal. *alveolaris* in the same sheath with *art. dental. inferior*. From this branches are given off to each root of the inferior molar teeth. As far as the entrance to the canal the *ram. mylo-hyoideus* accompanies it; in the canal it bifurcates at *foram. mentale* into two rami:

- a. *Ramus dentalis incisivus*, very fine, passes farther along the canal, and supplies the *cuspidati* and *incisor* teeth.
- b. *Ramus mentalis*, stronger, passes out at the *foram. mentale*, ramifies in the skin and mucous membrane of the under lip, particularly at its free border, and forms, with *n. facialis*, a *plexus mentalis*.

3. *N. lingualis*, the nerve of the sense of touch and sensation of the tongue, corresponds to *n. nasalis* and *palatinus* of the first and second division, is situated farther forwards than the last, takes a curve forwards and downwards, at first between *m. pterygoideus extern.* and *pharynx*, then between the two *pterygoidei*, *pteryg. internus* and the *ramus* of the lower jaw; thence directly forwards along the superior border of the sub-maxillary gland, between this and the mucous membrane of the mouth, above *m. mylo-hyoideus*, lastly obliquely beneath the sublingual gland, on

its internal side to the border of the tongue, and between *m. mylo-* and *genio-glossus* into the substance of the tongue; it lies above *n. hypoglossus*, and terminates in tufts upon the mucous membrane and the papillæ at the borders and the tip of the tongue. Between the *mm. pterygoidei* it receives the *chorda tympani*, which blends with it behind at an acute angle; farther a connecting branch from *n. alveolaris inferior*. It gives branches to the *tonsilla*, the mucous membrane of the cheeks, and the gums; from its inferior surface filaments pass to the *ganglion linguale*; lastly, also, to the *gland. sublingualis*, and there forms a *pl. sublingualis*.

Ganglion glotticum s. linguale s. maxillare. The lingual ganglion is placed in the curve of *n. lingualis* between it and the *gland sub-maxillaris*, at the side of the root of the tongue, opposite the last molar tooth, covered by the mucous membrane. Its three roots are received; 1. from the *chorda tympani* of *n. facialis* (motor); 2. from *nerv. lingualis* (sensitive); 3. from the first cervical ganglion of *n. sympathicus*. From it branches pass off; 1. to the *ductus Whartonianus* (for the excretion of saliva in the act of tasting); 2. to the *n. lingualis* (as from *gangl. oticum* to the *auricularis* from *g. ophthalmicum* to the *n. opticus*) of *hypoglossus*.

4. *Nervi masticatorii*, the three branches, contain the fibres of the *portio minor n. trigemini*. They are:

1. *N. mylo-hyoideus* passes downwards in a sheath, with *nerv. alveolaris inferior* as far as *foram. alveolare poster.*, then in the *sulcus mylo-hyoid.* of the lower jaw, and ramifies in *m. mylo-hyoideus*, and the anterior belly of *m. biventer* (the posterior belly of which is supplied by *n. facialis*).
2. *N. massetericus* inclines backwards and over *incisura semilunaris* outwards, and sinks into *m. masseter*. Above, a deeper branch goes to the temporal fossa and to the maxillary articulation.
3. *N. temporalis profundus*, frequently double, passes upwards close to the wall of the temporal fossæ, anastomosing with branches of *masseteric.*, *buccinator.*, and *temporalis superficialis*; with *lacrymalis* and *subcutaneus*, and loses itself in the *mus. temporalis*.
4. *N. buccinatorius*, a larger branch, penetrates the *m. pterygoid. extern.*, gives temporal twigs, passes downwards between *m. pterygoid. ext.* and *temporal.*, behind *proc. coronoid.* to *m. buccinator*, anastomosing behind *duct. Stenonianus* in a curve with *nerv. facialis*, and giving branches to the muscles of the angles of the mouth.

5. *Nn. pterygoidei externus* and *internus* to the muscles of the same name. The last gives filaments to *m. tensor palati* and *tympani* by means of *gangl. oticum*. (Hence the *membrana tympani* is stretched by the pterygoid muscles in loud sounds, &c.) [?].

Distribution of the *Trigeminus* :

- a. It perforates all the muscles of the face ;
- b. Supplies the pterygoid muscles (with *motor nerves*) ;
- c. Supplies the skin of the whole face ;
- d. The teeth, gums, and jaws ;
- e. Enters into the organs of smell, sight, hearing, taste, endowing them with common feeling, but not the specific sensation of smell, sight, &c. ; and also nutrition, e. g. in the *conjunctiva* of the eyes.

638. VI. *N. abducens*, the nerve for the *external rectus* muscle.

Origin : with two roots : a. from the posterior border of *pons Varolii* ; b. from the superior part of *corpus pyramidale*. Course : upwards and rather outwards from under the pons, perforates the *dura mater*, and passes inwards over the apex of the petrous bone into the *cavernous sinus*. Here it lies on the outer side of *carotis* and to the inside of the veins of the *sinus*, and receives two branches from *plex. caroticus* and one from *n. ophthalmicus* ; it then passes directly forwards through the *fissura orbitalis superior* into the *orbita*, [between the two origins of] *m. rectus externus*, lying there on its internal surface above the *n. oculo-motorius*, under *n. ophthalmicus*.

639. VII. *N. facialis s. communicans faciei*,

formerly known as *portio dura paris VII.*, is a mixed nerve, which arises with two roots ; the *larger anterior* (motor) root from the posterior border of *pons Varol.*, in the fossa between this and the *medulla oblongata* ; the *smaller posterior* (sensitive), from *corpus restiforme*, where the auditory nerve arises (hence the guidance of the undulations producing sound to the ear by means of *n. facialis*). Course : external to and above in front of *n. acusticus*, with which it passes along to the *meatus auditorius internus*.

Pars petrosa. In the auditory meatus the nerve gives a small filament to *n. acusticus*,—it enters the *canalis Fallopii*, forms at the *hiatus c. Fall.* a curve—the bend—around the cavity of the

tympanum, and passes out through the *foram. stylomastoideum* to the face. At the bend the small root forms a ganglionic enlargement, this is :

ganglion geniculatum, a grayish-red, triangular ganglion which receives the *n. Vidian. superficial.* (of *nerv. trigemin.*) and gives off; a. some minute filaments which again sink backwards into the auditory nerve with a reddish enlargement; b. a filament, which passes to the long root of *gangl. oticum*. Before it leaves the canal the *n. facialis* gives off:

1. *Ram. ad fenestram ovalem* going along through a small canal in the posterior part of the *fenestra ovalis*.
2. *Nervus stapedii*, passes obliquely inwards to the muscular portion of *m. staped.*
3. *Chorda tympani*, that is, a nerve which runs along a canal peculiar to it (*canal chordæ*), in the posterior wall of the tympanum, backwards and upwards, then forwards in the arch through the cavity of the tympanum, free, between the long crus of the incus and the manubrium of the malleus, and passing forth from a small foramen in the centre of *fissura Glasseri*, it applies itself to *n. lingualis*, and gives a long motor root to the *ganglion linguale*.
4. *Rami communicantes cum n. vago*, come from the auricular branch of *n. vagus*, two small branches.

Having made its exit at the *foram. stylo-mast.* the *n. facialis*, whilst situated behind the *parotis*, gives off the following branches :

5. *N. auriculo-occipitalis* s. *occipitalis posterior*, inclines, from the *stylo-mastoid foramen* upwards, and divides into a larger *ram. occipitalis*, which ramifies in the *m. occipit.*, the perosteum, and on the vessels, and anastomoses with a filament of *plex. cervicalis*; and into a *ram. auricularis*, which supplies the *mm. retrahentes* of the auricle [and the other muscles] and anastomoses with the *rr. temporales* of *n. trigemini* and *facialis* and the *auricular* branch of *n. vagus*.
6. *N. stylo-hyoideus* inclines obliquely outwards to the *m. stylo-hyoid.*, and anastomoses with the *n. sympathicus* and first cervical nerve.
7. *N. digastricus* to the posterior belly of *m. digastricus*, gives branches to the *carotis*, and unites with *n. vagus*, *trigeminus* and *sympathicus*.
8. *Rami parotidei posteriores* come partly from the trunk, partly from the branches, and terminate in the substance of the *parotis*.

After this the trunk curves forwards in the anterior half of the

parotid, and divides into three, rarely two, diverging branches, which form a large plexus (*plexus parotideus* s. *anserinus*) which surrounds the *art. temporalis* with a posterior loop. From this pass into the face :

1. *Nn. zygomatici*, five branches. The three first (also *temporales*) arise close under the auricle, ascend above the zygomatic process, give branches to the auricle, to the temple, *mm. frontalis* and *orbicularis*, at the outer angle of the orbit, and unite with one another, with *subcutan. male* and *temporal. superficialis*. The fourth, frequently a branch of the third, is situated more deeply, ramifying below in the *m. orbicularis*. The fifth is larger, sends a superior branch to the inferior eyelid to the *n. infraorbitalis*; an inferior to the *art. auricular. inferior* and filaments to the fat below the malar bone.
2. *Nn. faciales* s. *buccales*, four branches, passing over *m. masseter* forwards, supplying the *ductus Stenonian.*, the vessels and muscles of the face, of the inferior part of the forehead, of the nose, of the lower eyelid downwards as far as *risorius Santorini*. They anastomose with *n. infraorbitalis* and its plexus.
3. *N. marginalis maxillæ inferioris* s. *labio-mentalis*, descends to the angle of the lower jaw, bends forwards and passes over the horizontal ramus of the lower jaw with a superior branch for the upper portion of the lower lip, with an inferior branch to the chin joining the *plexus mentalis* of *n. mentalis* (see *trigemin.*)
4. *Nervi ad plexum platysmamyioideum*, generally three branches, descend on the vertical ramus of the lower jaw to the *m. platysmamyoides* anastomosing with the last nerve and the third cervical; they reach to the region of the larynx.

640. VIII. *Nervus acusticus*, the nerve of Hearing, formerly *portio mollis paris VII.*, arises: 1. In the rhomboidal fossa, behind *n. facialis*, from *corp. restiforme*; 2. From *crus cerebelli superius*, around which it bends; coming forth behind the *pons* and passing on the outer side of *n. facialis*, which it receives in a groove, outwards and upwards to the *internal auditory meatus*. Here it unites by means of filaments with the *n. facialis*; and divides into an anterior (*n. cochleæ*) and a posterior (*n. vestibuli*) principal branch which pass through the foramina in the base of the auditory meatus to the labyrinth.

1. *N. cochleæ*, passes through the anterior foramen with spirally-arranged fibres, becoming the more so as they approach the *modiolus*, sending its branches through the *tractus spiralis foraminulentus*, which form loops upon the *lamina spiralis*, and terminate at the *infundibulum*.

2. *N. vestibuli*, passes backwards and divides into three branches which go through three fossæ to the vestibule. A grayish-red enlargement is found on it, like the auditory nerve which is generally rather reddish.

- a. *N. saccularis major*, passes obliquely forwards to the superior fossa and its canaliculi into the *saccus oblongus* and the ampulla of the superior and external semicircular canals.
- b. *N. saccularis minor*, more horizontal to the *saccus hemisphericus*.
- c. *N. ampullaris inferior*, deeper, through the external fossa to the ampulla of the posterior semicircular canal.

641.

IX. *N. glosso-pharyngeus*.

Origin : with a series of filaments (two roots) from *corp. restiforme*, above *n. vagus*, below *n. facialis*; passing out between *corp. restiforme* and *olivare*. Course: the trunk passes, a distance of from one half to three quarters of an inch outwards, forwards and rather upwards to the anterior part of *foram. jugulare*, separated from the *n. vagus* by a vessel, forms two ganglia, passes out from the cranial cavity, and divides into two branches. Situation: in the *foram. jugulare*; in front and above, before *n. vagus* and *accessorius*, before and on the inner side of *v. jugularis interna*, in a canal of *dura mater*; below the foramen: united with a ramus of *n. sympathicus*, curved forwards and downwards on the outer surface of *carotis interna*, on the internal of *m. stylo-pharyngeus*, removed from *v. jugularis int.*, *n. accessorius* and *vagus*. Junctions: with *n. vagus*, its auricular and pharyngeal branch with *plexus caroticus*; and with *n. facialis* in the *m. digastricus*.

1. *Ganglion jugulare* (Ehrenritter, J. Müller), lies (from a half to one line long and broad) upon the posterior fasciculus of *glosso-pharyngeus*, the anterior and posterior roots of which unite above and below it, in the superior part of the *foram. jugulare*. Below it (from two to four lines) lies a larger ganglion.

2. *Ganglion petrosum* (Andersch). It is oval, one and a half to two lines long, situated in the *vellecula* of the petrous bone, and receives on its superior and anterior part:

Nerv. tympanicus s. *Jacobsonii*. The tympanic nerve ascends by means of a peculiar canal (upon the crest between *canal caro-*

ticus and *fossa jugularis*) to the inner wall of the tympanum, is surrounded by a thin ganglionic mass (*gangliolum tympan.*) receives a filament from *plex. caroticus*, and gives a branch to the *fenestræ rotund.* and *ovalis*. Below the last the trunk bends round, forwards and downwards, passes through *tuba Eustachii*, perforates its cartilage, and terminates in the glands about its orifice. Two branches, besides, pass off on a plane with the *fenestra ovalis*.

a. *N. petrosus profundus minor*, passes through a canal of the septum between *tuba Eustachii* and *canal. caroticus* in the last to the *plex. carotic.*, where it unites with *ram. prof. n. Vidian.*

b. *Ram. communicans n. petrosi-superficialis minoris*, passes in a canal behind the *tubæ Eustachii* upon the anterior surface of the petrous bone to *n. petros. superf. minor* (see *nerv. facialis*), which passes through *foram. spinos.* to *gangl. oticum*.

(*Plexus tympanicus major*, Jacobson's anastomosis is principally formed by a., lies upon the internal wall of the *tympanum*, supplies the mucous membrane and osseous substance, and is probably in connexion with the *chorda tympani*.)

3. *Ramus pharyngeus*, divides into from two to three branches, which form, with those of *n. vagus*, the *plex. pharyngeus*, and supply *m. constrictor super. and med.* and the posterior part of the pharynx.

4. *Ramus lingualis*, the nerve of taste, the continuation of the trunk, passes in a curve, convex behind, from the *carotis interna* to the root of the tongue, giving, in this course, branches to *m. stylo-pharyngeus*, which lies before it, to the tonsils above, to the mucous membrane of the root of the tongue, where it anastomoses with *n. maxillaris inferior*. In the root of the tongue it divides immediately into an *external* branch for the mucous membrane of the border and the inferior surface, and an *internal* branch for the *posterior third* of the mucous membrane, as it forms a plexus about the *foramen cæcum*. Both unite with *n. maxillar. inferior* and *trigemini*.

642. X. *N. Vagus* s. *pneumogastricus*, the Vagus nerve.

Origin: with from twelve to sixteen filaments (united into from six to eight fasciculi) from the central columns of *medulla oblong.* between *corp. olivare* and *restiforme*. Course: under the cerebellum obliquely downwards, forwards and outwards to the anterior part of the *foram. jugulare*. It here lies in an especial sheath

(of *dura mater*) behind *nerv. glosso-pharyng.*; before *v. jugular. interna*; it forms a ganglion to which *nerv. accessor. Willisii* is applied. Below the *foram. jugulare* it forms a *plexus ganglioformis*; is placed at first before, then on the inner side of *ven. jugularis, n. accessor.* and *hypoglossus*; it passes downwards along the neck behind *carotis* (within) and *jugularis* (without), in one sheath with them, separated from *n. sympathicus* (which is behind and outside) by uniting tissue, to the thorax, and from this with the *œsophagus* through the *diaphragm*, where it terminates in the *plexus solaris* on the stomach.

643. (I.) The cranial portion.

a. *Ganglion. jugulare n. vagi*, lies, almost enclosed in *dura mater*, in the superior part of the *for. jugulare*, oval, flat, and two lines long, receives a few filaments from *n. accessorius, glosso-pharyng., sympathicus* and *facialis*. From its anterior external side arises:

1. *N. auricularis*. The auricular branch passes round the *bulbus v. jugul.* forwards, gives a filament to *n. Jacobsonii*, passes through a canal behind *proc. styloideus* into the *canal. Fallopice*, here anastomoses with *n. facialis*, passes through a canal in the *proc. mastoid.* again outwards to the skin of the posterior part of the *external auditory meatus*. (Important on account of the sympathy existing between the Ear, Lungs, and Stomach.—ARNOLD.)
2. Connecting twigs with the *gangl. cervicale I.* (See this.)

644. (II.) The cervical portion.

b. *Plexus ganglioformis s. nodosus*, lies half an inch below the *foram. jugulare*, and is a loose plexus of the fasciculi of the *vagus*, the meshes of which are filled with a grayish-red fat. It unites with *nerv. hypoglossus, glosso-pharyng.* and *sympathicus*, sometimes also with the first cervical nerves. From it arise:

1. *Nn. pharyngei*. The *superior* pharyngeal nerve unites with *n. hypoglossus*, passes to *m. constrictor super.*, and the mucous membrane. The delicate *middle* unites with *n. pharyngeus*, the *glosso-pharyng.*, and passes with these also to the superior part of the pharynx. The inferior descend obliquely, unite with *n. sympathicus*, and terminate in *m. constrictor medius* and *crico-pharyngeus*. They form:

Plexus pharyngeus, lying on the lateral walls of the pharynx, entwining around the *art. pharyng. ascendens*, and terminating in the muscles and the mucous membrane. At the superior part fibres generally come from *glossophar.*, in the middle from *n. vagus*, below from *vagus* and *sympathicus*.

2. *N. laryngeus superior*. The superior laryngeal nerve (principally a sensitive nerve) arises on the inner side, and passes along it close to the pharynx, obliquely behind the *carotis interna* forwards and inwards, and divides into :
 1. *N. laryngeus externus*, the smaller inferior branch arising sometimes from the trunk of the *vagus* itself, passes downwards and inwards, and at the side of the larynx forwards, between *m. constrictor infer.* and *thyroid. cartilage*, and is lost in the *m. crico-thyreoides* and upon the internal surface of the larynx—in the *m. crico-arytenoid*. It receives two filaments of *sympathetic*, and gives some to *n. cardiacus* behind *carotis interna* (this is, *plex. laryngeus*); farther, to *m. constrictor infer.* and *thyroid. gland*.
 2. *N. laryngeus internus*, continuation of the trunk, passes between *os. hyoid.* and larynx, enters into the last with *art. laryngea super.*, and divides beneath the mucous membrane in a radiating form into anterior and posterior branches. It supplies the mucous membrane of the epiglottis, the thyroid cartilage, *membr. hyo-thyreoid.*, of the vocal cords, of the *mm. arytenoidei* [merely perforating them in order to reach the mucous membrane], and anastomoses upon the posterior surface of the cricoid cartilage with *nerv. recurrens*.
- c. Several vascular branches pass over and under the point of bifurcation of *carotis*, forming *plexuses* about these vessels.
- d. *Rami cardiaci*, from two to four, arise below the region of the point of bifurcation of the *carotis*, pass downwards upon it, anastomosing with one another, and passing into the *plexus cardiacus* (of *sympathicus*). To these also belongs the *ram. descendens*, which passes from the posterior part of the *vagus*, in the inferior part of the neck above the *carotis*, partly to the *cardiac plexus*, partly to the *œsophagus*, and anastomoses with *n. sympathicus*.

645. (III.) The thoracic portion of the Vagus.

Upon the right side of the trunk passes between *ven.* and *art. subclavia*; upon the left, between *carotis communis* and *art. sub-*

clavia into the chest. Course as far as the roots of the lungs; upon the *right* side: behind *v. anonyma* and *cava super.*, in the sulcus between *trachea* and *œsophagus* downwards to a point behind the roots of the lung; upon the *left*: behind *v. anonyma* to the left of *arcus aortæ* and behind *bronchus sinister*. Hence it passes into the *cavum mediastin. postic.*, divided into two branches, upon the *right* side, behind, upon the *left*, before, the *œsophagus*, through the *foramen œsophageum* into the abdomen. Branches:

1. *Nerv. recurrens s. laryngeus inferior*, arises upon the *right* side (where it is frequently double) before the *art. subclavia*, upon the *left*, before the *arcus aortæ*, externally to the *ductus Botalli*, at the place where the *vagus* passes backwards; it bends itself under the vessels, and passes upwards behind them on the outer side between *trachea* and *œsophagus*, perforates *m. constrictor pharyngeus infer.*, and enters the larynx; terminating in the *m. crico-arytænoideus* [and *m. arytenoidei*]. It gives branches to the mucous membrane [!] and to the muscles as well to the constrictors as to the dilators of the larynx; also to the *œsophagus* and the *trachea* [the muscular fibres behind]; anastomosing with *n. laryngeus super.* and *n. sympathicus* by means of some *rami cardiaci*. It is principally a motor nerve.

2. *Rami cardiaci thoracici*, are from five to six larger, and several more delicate branches, which pass into the following plexus, or are lost upon the external surface of the *pericardium*.

Plexus cardiaci, formed of *vagus* and *sympathicus*, entwine about the great vessels of the heart, and are separated at the point of reflection of the *pericardium* into superior and inferior, but connected with each other as well as with those of the *œsophagus* and *trachea*.

3. *Rami tracheales inferiores*, lie on the anterior surface, close above the bifurcation of the *trachea*, intermingling at this point with *nerv. sympathicus* into a

Plexus trachealis anterior, which is connected with the internal cardiac plexus, and proceeds into the *plex. pulmonalis anterior*, which covers the *bronchi* in front.

On the posterior surface of the *trachea*, a *plexus tr. posterior* also arises, from six to seven branches, which is connected with the pharyngeal and cardiac plexus, and gives branches to the mucous membrane of the *bronchi*.

4. *Plexus pulmonalis posterior*, frequently arises from the trunk of the *vagus*; from four to six branches, upon the right and left side of the lungs. The *left* is the larger. Both are connected together with *plex. trachealis*, and enter the lungs with

the *bronchi*. Some filaments are lost in the pulmonary artery. Its posterior filaments belong to *n. sympathicus*, from its three superior ganglia.

5. *Plexus œsophageus inferior*, formed by the internal principal trunk of the *vagus*, which descends farther on the *œsophagus* below the *bronchi*, entwines around it, and penetrates between its coats. The *right vagus* passes more towards the posterior (*pl. œsoph. post.*); the left more towards the *anterior* surface (*pl. anterior*). Both anastomose with each other by large branches.

646. (IV.) The abdominal portion of the *Vagus*.

The *right trunk* enters behind, the left *before* the *œsophagus*, through the *foram. œsophageum*. Each is lost in a fasciculus, *rami gastrici*, and forms a *plexus gastricus*.

1. *Plex. gastricus anterior*, formed by the left *n. vagus*, lies upon the anterior surface along the small curvature from the *Cardia* to the *Pylorus*; gives branches to the *fundus ventriculi*; to the small omentum as far as *fossa transversa hepatis*.

2. *Plexus gastricus posterior*, formed by the right *n. vagus*, lies behind the *cardia*, is smaller than 1, and passes, principally, into the *plex. solaris*.

Connexions of the *n. vagus*: with *n. trigeminus*, *facialis*, *glosso-pharyngeus*, *accessorius Willis.*, *hypoglossus*, *cervicall. superr. 3*, and *sympathicus*.

Function. The *vagus* is entirely *sensitive* until its connexion with *n. accessor. Willis.*, then a *motor* nerve likewise.

647. XI. *N. accessorius Willisii*, the spinal accessory Nerve.

Origin: from the posterior part of the central columns of the spinal cord, between the posterior roots of the fourth to the sixth cervical nerves (sometimes even deeper) and *lig. denticulatum*; with six to seven radical filaments, which are strengthened by the posterior roots of the first (to the third) cervical nerves, but only pass in a sheath with them, and often present a small ganglion, but which belongs to the cervical nerves. *Course*: upwards on the sides of the spinal marrow, always becoming more distant from it; over the first cervical nerve, strengthened by some filaments, through the *foram. magnum* to the cranial cavity. It here passes in a curve downwards, forwards, and outwards, enveloped by the *dura mater*, to the *vagus*, passes into its sheath, on the outer side, and behind it, through *foram. jugulare*, pass-

ing on it and its ganglion, and dividing into its two branches. It is a motor nerve, and holds the same relation to the *vagus* as the posterior root of a spinal nerve does to the anterior.

1. *Ram. internus*, passes downwards, partly into the *nerv. pharyng. superior*, partly through the *plex. ganglioform* (probably into the *laryng. superior*, and) into the thorax, to the *nerv. recurrens*, the *pharyngeal* and *gastric plexus*.
2. *Ram. externus*, the posterior branch, the continuation of the trunk, descends behind *ven. jugular. interna* outwards and backwards, perforates *m. sternocleidomast.* at the superior third, gives branches to it, becomes enlarged by means of branches from the second and third cervical nerves, and enters the *m. trapezius* on the internal surface, ramifying in it as far downwards as its inferior extremity.

648. XII. *Nerv. Hypoglossus*, the lingual Nerve.

Origin : between *corp. pyramidale* and *olivare*, with ten to fifteen filaments, which unite into two fasciculi, in a row with the anterior roots of the spinal nerves, behind the *art. vertebralis*. Course : the two fasciculi, covered by the *pia mater*, perforate the *dura mater* separately, become covered by it, and ascend to the *foram. condyloid. anterius*, through which the united trunk passes out of the cranial cavity (one line thick). Hence it passes downwards and forwards, situated internal to and behind *n. accessorius*, *vagus*, and *v. jugularis interna* ; inclining in a curve from above, behind and internally over *vagus* and *carotis* (over the place of bifurcation) forwards, upwards, and inwards, to the tongue. Here it is situated, at first, internal to and under *m. digastricus*, then, above *art. thyreoid.* and *lingualis*, external to them, internal to *m. stylo-glossus*. Finally, it passes upwards and forwards into the flesh at the inferior surface of the tongue, covered by *gland. submaxillaris* and *m. mylo-hyoideus*, where it terminates at the apex.

Connecting branches with : the first cervical ganglion of the sympathetic, and the first and second cervical nerves, *n. vagus*, *n. lingualis trigemini*. Vascular branches : to *carotis* and *jugularis interna* and *art. lingualis*. Muscular branches for : *hyo-thyreoid.*, *genio-hyoideus*, *hyo-*, *stylo-*, *genio-glossus*, and *gland. submaxillaris*. Finally :

Ram. descend. hypoglossi, arises from the commencement of the curve, descends outside the *carotis* before the *vagus* (in the same sheath), anastomoses with it, the third cervical nerves [sometimes the second or even the fourth], gives

branches to *m. omo-hyoideus* [and a long filament for the posterior belly], *sterno-*, *hyo-*, and *thyreoideus*, and passes behind the last to the *plex. cardiac. super.*, and with another branch to the *nerv. phrenicus* in the *mediastin. anticum*. *Nerv. hypoglossus* is a motor nerve only.

649. The Spinal Nerves, *Nervi spinales*.

From thirty-one to thirty-two pairs are enumerated, namely : eight cervical, twelve dorsal, five lumbar, five sacral, and one to two coccygeal pairs of nerves.

They arise with two roots from the sides of the anterior and posterior columns of the *medulla spinalis*, connected with the gray matter in the interior.

The anterior (motor) root is smaller than the posterior, separated from it by means of the *ligam. denticulatum*, and arises from a narrow white line. The posterior (sensitive) root is stronger, arises from the gray lateral sulcus, and is provided with a ganglion (*ganglion spinale*).

Course. Both roots, enveloped in arachnoid, approach each other, without anastomosing, and pass out, even still surrounded by a sheath of the *dura mater*, through a corresponding intervertebral foramen. The superior spinal nerves pass off horizontally, and are shorter, the inferior at so much the more of an acute angle with the spinal cord, the nearer they approach its termination. The two roots unite into one trunk after their exit from the intervertebral foramen, which immediately divides into an anterior and posterior, and branches for the *n. sympathicus*. Fibres from the anterior as well as from posterior roots are united in these branches.

a. *Ganglia spinalia*, reddish, firm ganglia, formed by the *posterior roots* of the spinal nerves, are situated one in each intervertebral foramen; but those of the sacral and coccygeal nerves, while still within the *canalis spinalis* and the *dura mater*. They are so much the larger, the stronger their roots and the branches passing off. The anterior roots of the spinal nerves are merely applied to their anterior surfaces (according to Cruveilhier they are also united to them by fibres).

b. The *anterior branches* of the spinal nerves are, with the exception of the first and second cervical, much stronger than the posterior, flat, and pass forwards and outwards before the transverse processes. In the neck, the loins, and sacrum, they form loops by means of ascending and descending branches, in consequence of which a *plexus* arises, from which the nerves pass off

to the extremities, in particular. In the back (*nn. intercostales*) they pass singly, without forming a plexus.

c. The *posterior branches*, much smaller than the anterior, pass between the transverse processes (*foram. intervertebr. posterr.* Cruveilhier), and through the *foram. sacralia postt.* backwards, divide into several branches, and soon terminate in the muscles and the skin of the back from the *occiput* to the *coccyx*.

650. 1. The cervical nerves, *Nervi cervicales* (eight pairs).

Their *posterior branches* pass at first transversely inwards between *m. complexus* and *semispinalis*, perforate the *trapezius* from before backwards, and take a retrograde course beneath the skin transversely outwards; they also unite with the *plexus*. Those of the two first are larger than the anterior. The *anterior branches* form, principally, the *plexus cervicalis brachialis*.

651. a. The four superior cervical nerves

supply the skin and muscles of the occiput, nape of the neck and cervical region, and form the *plex. cervicalis*, from which *n. phrenicus* arises.

1. *Nerv. cervicalis I. s. infra occipitalis Aschii*, one of the smallest spinal nerves, passes forth under *art. vertebralis* (rarely over it) between *occiput* and *atlas*, behind *proc. obliquus*, and divides below the curvature of the *art. vertebralis*. Its larger *anterior* root contains from three to four fasciculi, the smaller *posterior* from two to three. It is situated farther forwards than the rest of the *posterior* roots, applies itself to the *n. accessorius*, and is said to be sometimes wanting. Its ganglion lies in the *foram. invertebrale*.

a. *Ramus anterior*, passes on the inner side of *art. vertebral.* in a sulcus of the *Atlas*, and bends downwards to form a loop with the second cervical nerve. Branches to the articulation of the *occiput*, *hypoglossus*, *gangl. cervicale I.*, *vagus* and *sympath.*, *art. vertebralis*, *mm. recti capitis antici* and *lateralis*, between which it pierces

b. *Ramus posterior*, larger than *a*, passes in the space between *mm. capitis obliqui* and *rect. postic.*, supplies these and *m. lateralis*, *biventer* and *complexus*.

652.

2. *N. cervicalis II.*,

far larger than *I.*, passes through between *atlas* and *dentatus*, farther backwards than the rest of the spinal nerves, and divides beneath *m. capit. obliq. inferior*, into :

- a. *Ram. anterior*, passing under *m. obliq. capit. inferior* forwards and outwards; gives branches to: the loops with the first and third cervical nerves, *ram. descend.* and *hypoglossi*, *nerv. vagus*, *accessorius*, *m. rect. capit. antic. major*, *sternocleidomast.*
- b. *Ram. posterior*, sometimes larger than *a*, gives ascending and descending branches to the posterior loops, besides to: *mm. obliquus capit. infer.*, *trachelomast.*, *complexus*, *splenius*, *semi-spinal. cervic.*, and the

Nerv. occipitalis major. This perforates the superior extremity of the *biventer cervicis* and *m. cucullaris*, supplies these, ascends between nape and occiput internal to, *art. occipital.*, is then situated beneath the skin, gives a curved branch to the middle line, others outwards and upwards, and reaches as far as the middle line of the vertex. It unites with *ram. poster.* of the third cervical, probably, also, with the temporal nerves.

653.

3. *N. cervicalis III.*,

passes obliquely upwards and outwards between the muscles, and transverse processes, through the second intervertebral foramen, and divides immediately into:

- a. *Ram. anterior*. Uniting with the second and fourth cervical nerves, the first cervical ganglion of the *sympathicus*, *recurrens hypoglossi*, it passes from behind into the centre of *m. sterno-cleidom.*, and gives:

1. *N. occipitalis minor*; frequently only a branch of the *occipit. major*, passing forth behind *m. sterno-cleidomast.* over *m. splenius capit.* and *proc. mastoid.* upwards, to the outer border of the *occiput*, ramifying in the skin. Branches to the muscles, to *n. facialis*, and the:

N. auricularis superior for the skin of the superior part of the external ear and *m. attolens*; it unites with *n. facialis* and *occipit. major*.

2. *N. auricularis magnus*, inclines round *m. sterno-cleidomast.*, forwards and upwards to its anterior border, where it divides (at the angle of the lower jaw), giving an auricular branch to the posterior part of the auricle from below upwards, which unites with *n. facialis*, and another to the *occiput*, which unites with *n. occipitalis*.

3. *Nn. subcutanei colli* (3). The superior inclines from behind over *m. sterno-cleidomast.*, obliquely forwards and upwards, external to *v. jugular. externa*, supplies the skin

with an anterior branch, going through the *parotis* as far as the angle of the mouth, and unites with *nerv. facialis*, with a posterior branch directly upwards to the skin on the anterior part of the auricle. The *central* unites with the last, giving branches *upwards* to the chin, *downwards* to the inferior region of the neck; the *inferior* inclines before the *ven. jugular. externa* inwards, sends branches to the most inferior region of the cervical skin, and on the chest.

- b. *Ramus posterior*, contributes to the posterior loop, passes under *proc. spin.* of the second vertebra and into the skin of the centre of the nape of the neck. Branches to: *m. trachelomastoid., transversal., complexus, splenius capit., semi-spinal, cervic. and trapezius.*

654.

4. *N. cervicalis IV.*,

passes out through the third intervertebral foramen, between the third and fourth cervical vertebræ, gives branches to *art. vertebralis*, and divides into:

- a. *Ram. ant.*, giving branches to *m. rectus capit. antic. major, longus colli, scalen. med., levat. scapul.*, to the third and fifth loops. From the last:

1. *Nn. supraclaviculares*, for the most part cutaneous nerves, which radiate in the inferior *trigonum cervicale* between *m. sterno-cleido-mast., trapezius* and clavicle; the *anterior* to the clavicle and mammary gland, the *central* to the axilla, the *posterior* to the scapula.
2. *Nerv. phrenicus respiratorius internus* (Ch. Bell), the diaphragmatic nerve, arises from the fourth cervical nerve, and is strengthened by filaments from the third, fifth, and sixth, even from the second and seventh; it unites with the superior cervical ganglion, sometimes with *hypoglossus* and *vagus*. Course: before *m. scalenus anticus*, downwards and inwards, and between *art. and v. subclavia* into the *cavum mediast. antic.* of the thorax. It is, here, between *Pleura* and *Pericardium*, before the roots of the lungs, without distributing any branches; on the *left* side it passes round the apex of the heart (therefore longer). It divides into two principal branches, which radiate upon the superior surface of the diaphragm, and partly pass to its inferior surface, where they anastomose with the *plexus phrenicus sympathici*. It is a *mixed* nerve, and gives rise, by its motor filaments, to the involuntary respiratory movements of the diaphragm, the two anterior thirds of which it supplies.

b. *Ram. posterior* is small, is distributed in the *m. multifid.*, *complexus*, gives other branches, and terminates in the *m. splenius capitis*, or upon the skin.

Plexus cervicalis, formed by the loops of the four superior cervical nerves (their anterior branches), is situated behind *m. sternocleidom.* and *ven. jugularis interna*, before the superior extremity of *m. scalenus med.* and *levat. scapulæ*, the third and fourth cervical vertebræ. Its branches have been described.

655.

b. The four inferior cervical nerves

supply more especially the skin and muscles of the superior extremity, as their strong anterior branches interlace, upon their exit from the intervertebral foramina, and form, with the first dorsal nerve, the *plexus brachialis*. The posterior branches are small, incline round *m. multifidus*, &c., supply *splenius*, *biventer*, &c., and terminate upon the skin of the middle line, at the inferior region of the neck.

656.

Plexus brachialis.

Situation: oblique from the inferior lateral region of the neck as far as the inner side of the head of the *humerus*. Its *superior* broader portion lying between the *mm. scaleni*, covered by a *fascia*, is situated above *art. subclavia* in the *trigonum cervicale inferius*, and is connected above with *plex. cervicalis* and *n. phrenicus*. Its *central* narrower portion between *clavicle* and *first rib*, behind *art. axillaris*. Its *inferior* portion in the axilla, behind the *m. pectoralis major*, before the *scapulo-humeral* articulation, separated from this by the tendons of the *m. subscapularis*, surrounds the *art. axillaris*. The branches are spirally interwoven.

657.

a. Respiratory nerves, the branches of the
pars supra-clavicularis.

1. *N. dorsalis scapulæ*, arises from the *ram. anter.* of the fifth cervical vertebra, descends obliquely backwards through the *m. scalen. medius*, above *levator. scap.*, and with *art. dorsalis scapulæ* on the internal surface of *mm. rhomboidei*; distributes muscular branches.

2. *N. thoracicus longus (posterior) s. respiratorius externus Bellii*, arises with three roots, from the fifth to seventh cervical nerves, which perforate the *scalenus medius*. Its trunk descends on the external surface of *serratus antic. major* as far as its inferior extremity, before *m. scapularis*; its branches pass in arches into the *Serratus Magnus*.

3. *Nn. thoracici anteriores*, arise from the anterior portion of the brachial plexus, above the *m. subclavius*, from the fifth to seventh cervical nerves, pass inwards, before and behind *art. axillaris* to *m. pectoral. major and minor*; a filament along the *clavicula*. Branches: to *m. subclav.*, *deltoid.*, even to the skin of the mammary gland.

4. *N. suprascapularis* arises from the fifth, and is enlarged by the sixth and seventh cervical nerves, passes backwards, outwards, and downwards along the *m. omo-hyoid.* and with the *vena transversa scap.* goes through the *incisura scapul.*, beneath the *lig. transvers.*, whilst the artery passes over it. (In consequence of becoming enlarged the vein presses upon this nerve; hence pains about the shoulder in diseases of the heart.) It supplies *m. supra- and infra-spinatus*.

5. *Nn. subscapulares*, two branches, arise from the fifth to seventh cervical nerves, sometimes from *n. axillaris*, pass backwards and downwards, giving branches to *m. teres major*, and sinking into *m. subscapularis*.

6. *N. marginalis scapulæ s. subscapularis longus*, arises from the inferior central part of the plexus, passes with *art. subscapul.* to the outer border of the shoulder blade, giving branches to: *m. serrat. antic. maj.* and *latiss. dorsi*.

658. b. The nerves of the arm, branches of the *pars axillaris* of the brachial plexus.

There are three cutaneous and four muscular nerves.

Of these, the

<i>N. Axillaris</i>	supplies	the <i>m. deltoideus</i> and <i>teres minor</i> ;
<i>N. musculo-cutaneus</i>	—	the <i>flexors</i> of the fore-arm;
<i>N. radialis</i>	—	the <i>extensors</i> of the fore-arm and the hand, and the <i>supinators</i> ;
<i>N. medianus</i> and <i>ulnaris</i>	—	the <i>flexors</i> and <i>pronators</i> of the hand and fingers.

659.

Cutaneous nerves.

1. *N. cutaneus brachii internus (minor s. ulnaris)*, arises from the loops of the seventh cervical and first dorsal nerves, passes into the axilla on the internal posterior side of *ven. axillar.*, then on the internal side of the *humerus*, perforates the *fasc. brachial.* in the middle third and inclines outwards. It supplies above, the

skin of the arm, on the *posterior* surface, downwards as far as the olecranon, on the inside ; as well as the *anterior* surface ; uniting above the *olecranon* with the principal trunk of the middle cutaneous nerve.

2. *N. cutaneus medius* s. *internus major*, arises from the inferior portion of the *plexus* or from *n. ulnaris* and *medianus* (at first on the *ven. axillar.*, then on the *ven. basilica*), afterwards between them, downwards along the boundary of the anterior and internal surface of the upper arm, beneath the fascia, giving above branches to the axilla and to the skin along the *m. biceps*, and divides into an external branch for the anterior surface and an internal for the ulnar border of the fore-arm, the branches of which extend as far as the carpal articulation.

In the bend of the arm it is situated over *ven. mediana*, rather internally, towards the *condylus internus*. (The outer side of the vein is therefore selected in venesection.)

3. *N. cutaneus externus* s. *musculo-cutaneus* s. *perforans Casserii*, arises close to the *n. medianus* or with it, from the fifth to the seventh cervical nerves, perforates the *m. coracoideus* and passes obliquely between *biceps* and *brachial. intern.* outwards, passes downwards to the *v. cephalica*, and close to this on the fore-arm, in the inferior half of which it divides into a volar and a branch for the radial border, which terminates in the skin over the carpal articulation. Branches to: *m. coraco-brachialis*, *biceps*, *brachialis internus*, and to the skin of the anterior surface of the lower arm.

660.

Muscular nerves.

4. *N. axillaris* s. *circumflexus humeri*, arises from the inferior, middle part of the *plexus*, curves inwards and backwards, behind *anconæus long.* [triceps] around the highest part of the *humerus* with *art. circumfl. humeri post.*, and terminates in the skin between the axilla and upper arm on the posterior surface. Branches to: *m. subscapul.*, [?] *teres major* [?] and *minor*, *deltoid*, to *art. axillaris*, the shoulder joint, and into the bones ; lastly :

N. cutaneus humeri posterior superior [there are generally two, even three branches], perforates the *m. deltoideus*, and ramifies in the posterior, superior, and outer region of the upper arm.

5. *Nerv. ulnaris* s. *cubitalis*, arises from the inner part of the *plexus*, from the sixth to the eighth cervical, and first dorsal nerve, passes downwards on the inner side of *art. axillar.* and *brachialis* behind *ven. axillaris*, perforates the fascia, and goes between

m. triceps and the *lig. intermuscul. intern.* under the skin to the groove behind the *condylus internus*, between it and *olecranon*, without giving off branches. Hence it passes between *proc. coronoid.* of *ulna* and *flexor carpi ulnaris* [between the origins of this muscle], and passes on the ulnar side of the anterior surface of the fore-arm, and divides in its inferior third into a volar and dorsal branch. At this point it lies under *m. flex. carp. ulnaris* and *digit. superficialis*, above the *profundus*; at first over, then internal to *art. ulnaris*. Branches to *m. flex. carpi ulnar.*, *digit. superfic.* [*profundus*]; one branch accompanies *art. ulnaris* to the skin of the volar surface of the *carpus*, as it perforates the *fascia antibrachii*.

a. *Ram. dorsalis manus*, passes between *flex. carpi ulnaris* and *ulna*, supplies the skin on the ulnar border of the fore-arm and divides on the *carpus*.

a. *Ram. sublimis* supplies the back of the fifth and fourth fingers on each side, that of the third finger on the ulnar side, with one branch.

b. *Ram. profundus* (small) winds round over the *capitulum ulnæ* upon the back of the hand, where it anastomoses towards the radial side.

b. *Ram. volaris*, the continuation of the trunk, passes on the inner side of *art. ulnaris* under the tendon of *flexor carpi*, and enters, between *lig. carp. vol. commune* and *proprium*, passing close to the *os pisiforme* into the hollow of the hand, and divides into:

a. *Ram. sublimis*, supplies the ulnar side of the little finger on the palmar surface.

b. *Ram. medius*, supplies the radial side of the little and the ulnar side of the fourth (ring) finger.

c. *Ram. profundus*, supplies the muscles of the little finger, forms a loop on the *os pisiforme* with the corresponding branches of the former; passes on the *arcus profundus arteriosus* to the *mm. interossei*, *adduct. pollicis* [and the two *lumbricales* nearest the little finger.]

6. *N. medianus*; arises from the fifth cervical to the first dorsal nerves, from the outer part of the *plexus*, often united with *n. musculocutan.*; surrounds *art. axillaris*; passes downwards on the outer side of *art. brachialis*, on the inner of *m. biceps*, afterwards over the artery and to its inner side, through *plica cubiti* to the forearm, without giving branches. Descends from the centre of the bend of the elbow over *art. ulnaris* and behind *m. pronator teres* [often perforating it], is then situated in the inferior half of

the forearm between *flexor digitor sublimis* and *profundus*; finally, it passes between the tendons of *flexor. digit. sublim.* and *carpi radialis* behind *lig. carpi volare proprium* to the hollow of the hand, where it divides into four branches.

Branches to: *art. interossea*, to the hollow of the hand (*r. cutaneus longus*) [or palmar cutaneus], and to all muscles of the flexor side of the fore-arm, except *flexor carpi ulnaris*.

- a. *Ram. volaris internus*, supplies the skin of the hollow of the hand, the third *lumbricalis* [sometimes], and the collateral surfaces of the third and fourth fingers.
- b. *Ram. medius internus*, supplies the second *m. lumbric.*, and the collateral surfaces of the second and third fingers.
- c. *Ram. medius externus*, supplies the first *m. lumbric.*, and the collateral surfaces of the second and first fingers, and the external of the last.
- d. *Ram. externus*, muscular branches for *flexor. brevis*, *abductor*, and *opponens pollicis*.
- [e. *Ram. interosseus*, accompanying the *art. inteross. ant.*, supplies the *pron. radii quad.*]

7. *N. radialis* s. *spiralis*, in size and course resembling the median, arises from the fifth to the eighth cervical nerves from the posterior part of the *plexus*. Course: it winds round the posterior surface of the upper arm outwards, forwards, and downwards towards the fore-arm, as it passes down upon the anterior internal surface of *condylus externus*, and divides at the flexure of the arm. Position: at first behind *art. axillaris*, and separated by it from *n. ulnaris* and *medianus*, then close to the bone in a sulcus between the heads of the *triceps m.*, finally passing out obliquely between *brachialis internus* and *supinator longus* over the *condylus externus*.

Branches: a long cutaneous branch, which reaches down as low as the back of the hand, and to all the *extensor* muscles, except *m. extensor carpi ulnaris* [?].

- a. *Ram. dorsalis* s. *ram. superficialis*, continuation of the trunk, passes (on the outer side of *art. radial.*) under *supinator longus* upon the dorsal surface of the fore-arm, perforates the fascia below its centre, and divides into an external and internal branch.
 - a. *Ram. anterior*, passes down upon the *extens. pollic. brevis*, gives branches to the volar surface of the skin of the ball of the thumb, and terminates as *n. dorsal. radialis pollicis* on that organ.
 - β. *Ram. posterior*, supplies the dorsal side of the collateral

surfaces of the first and second, and those of the second and third fingers.

- b. *Ram. profundus s. muscularis*, passes through or under *m. supinator brevis* upon the dorsal surface of the fore-arm, supplies the *extensor* muscles, and passes close upon the *lig. interosseum* (as *n. interosseus externus*), to terminate upon the carpal articulation.

661. II. The Nerves of the Back, *Nervi dorsales* (twelve pairs).

The first passes out between the first and second dorsal, the last between the twelfth dorsal and first lumbar vertebra. Their roots are smaller, and lie more widely asunder than those of the other spinal nerves; their trunks also are less developed. They traverse a greater length of the *canal. spinalis*, form their ganglia, and soon divide after their exit from the intervertebral foramen. By means of frequent anastomoses, they form arched loops with each other, and give off roots to the *nerv. sympathicus*.

1. Posterior branches, *rami dorsales*, smaller than the anterior, turn round between *lig. colli costæ extern.* and *intern.*, backwards, and divide into an external and internal branch.

a. *Rami externi*, turn outwards:

α. Those of the seven superior, smaller, pass out between the transverse processes; pass between *m. longissim.* and *sacro-lumbalis*, give branches to them, to *cervical. descend.* and *transversal.*, to *levator costarum*, and the over-lying skin.

β. Those of the five inferior are larger, perforate the tendons of *serratus posticus* and *latissimus dorsi*, and terminate below in the skin.

b. *Rami interni*, are larger in the seven superior dorsal nerves; pass upon *m. multifid. spinæ*, inwards and downwards towards the transverse processes, give branches to *m. multifid.*, *semi-spinal. cervicis* and *dorsi*, *mm. interspinales*, perforate the superficial muscles, and spread out, as the two are associated together, externally in the skin of the back.

2. The anterior branches, *nervi intercostales*, pass between the ribs before the *lig. colli costæ intern.*, traverse, below the *vasa intercostalis*, the *sulcus costalis*, between *mm. intercostales externi* and *interni*, forwards and outwards, and divide in the middle between *vertebræ* and *sternum* into an internal and external branch. The anterior branch of the first dorsal nerve assists in forming the *plex. brachialis*, as its superior branch passes upwards behind *art.*

maxillaris to the eighth cervical nerve; its *inferior* branch traverses as *intercostal* nerve along the first rib.

a. *Rami interni* s. *profundi* continue to pass in the direction of the trunk, along the inferior borders of the ribs as far as the middle line of the chest and abdomen.

α. The thoracic (*r. thoracici interni*), these are the branches of the second to the seventh intercostal nerves, which give small branches to the *mm. intercostales* and *triangularis sterni* (of the third to the seventh), perforate at the outer border of the sternum the *mm. intercostal.* and *pectoralis major*, are again reflected outwards, supplying the mammary gland and skin, and unite as *internal* cutaneous nerves of the chest with the external.

β. The abdominal branches (*r. abdominales interni*); these are, the branches of the eighth to the twelfth intercostal nerves, are larger, give branches to the *mm. intercostales*, pass behind the cartilages of the short ribs, and traverse between *mm. obliquus intern.* and *transversus abdom.* to and in the sheath of *m. rectus*, supplying the muscles and skin of the anterior abdominal walls.

b. *Rami externi* s. *laterales* perforate (the twelfth excepted) the *m. intercostal. extern.* from behind forwards, then pass forth on the lateral walls of the chest and abdomen, and divide immediately into an anterior and posterior branch.

a. The thoracic branches (*r. thoracici externi*), that is, the second to the seventh branch, passing forth between the digitations of *m. serratus antic. major*. Their *anterior* branches are reflected inwards, and ramify in the skin of the *thorax*. Their *posterior* branches, backwards upon *n. latissimus dorsi*, give filaments to it, and terminate in the skin of the *back*. The posterior branch [intercosto-humeral] of the second and third *n. intercostal.* goes to the skin of the upper arm, and forms the *posterior cutaneous nerves* of the *superior* third of this region of the upper extremity [Nn. Wrisbergii].

β. The abdominal branches (*rami abdominales externi*), that is, the eighth to the twelfth branch, passing out between the digitations of *m. obliquus extern.* Their *anterior* branches are reflected inwards, give a branch to *m. obliq. extern.*, and ramify in the skin of the lower part of the anterior abdominal parietes. Their *posterior* branches pass backwards to the skin of the *lumbar* region.

662. III. The lumbar, abdominal nerves, *Nervi lumbales*,
(eight pairs.)

The first passes out between the twelfth dorsal and first lumbar vertebra, the fifth between the fifth abdominal and the sacrum. Their roots lie closer together, belong to the *cauda equina*, and pass tolerably far downwards in the *canal. spinalis*; they are not united, like the earlier spinal nerves, by means of interposed filaments. The *ganglia* of the lower are situated in the *canalis spinalis*. The trunk divides, soon after its exit from the intervertebral foramen, into an anterior and posterior branch.

The *anterior* branches increase at the origin from the first to the fifth, unite by means of two or several filaments with *n. sympathicus*, pass through *m. psoas major*, and associate in *loops* before the transverse processes of the abdominal vertebræ, the four superior of which form *plex. lumbalis*, while the fifth belongs to the *plex. sacralis*.

2. The *posterior* branches decrease in size from the first to the fifth, are soon reflected backwards between the transverse processes and their muscles, and divide into :

- a. *Internal* branches. They pass in the groove on the basis of the transverse process to *m. multifidus* and *interspinales*. The fifth branch unites with the first *n. sacralis*.
- b. *External* branches. They are larger, go to *mm. intertransversarii* and *sacro-lumbalis*. The three first distribute *nn. cutanei superiores* [*lumbo-glutæal*] to the glutæal region.

663. *Plexus lumbalis*.

The lumbar plexus is formed by the loops of the second, third, fourth, and a small branch of the first abdominal nerve, and is situated on the sides of the bodies of the lumbar vertebræ between the transverse processes and the fasciculi of *psoas major*. Three secondary and three principal branches pass off from it, the former of which belong to the first and second lumbar nerves as *nn. abdominales*, and pass between *m. psoas* and *iliacus* on one side and the *peritoneum* on the other, to the crural arch; the latter supply the inferior extremity.

664. a. The secondary branches, abdominal branches.

1. *N. ileo-hypogastricus* arises from the first lumbar nerve, perforates the *psoas*, passes outwards before *m. quadrat. lumbor.* downwards towards the *crista ilei*, penetrates *m. transvers. abdom.*, passes, between *m. transversus* and *obliquus internus*, along the

crista ilei, and terminates in the skin over the abdominal ring and *mons Veneris*, or passes through the inguinal canal. It supplies the above-mentioned muscles.

2. *N. ileo-inguinalis* arises from the first lumbar nerve or the first loop, perforates *m. psoas* farther forwards, and the *m. transversus* in the neighbourhood of *spina ilei anterior super.*, after that the *obliq. intern.*, and passes over the spermatic cord (or the round ligament), through the abdominal ring to the skin of the pubic region (*mons Veneris*) and the anterior external part of the *scrotum* (or the *labia externa*), sometimes even to the thigh.

3. *N. genito-cruralis* arises from the second lumbar nerve, or the second loop, perforates the *psoas* close in front, passes downwards, forwards and outwards upon its anterior surface, and divides in the inguinal region into an internal and external branch.

a. *Ram. externus* s. *lumbo-inguinalis*, passes off obliquely, from the *psoas* to the *m. iliacus* outwards, and passes upon this with an *external* branch to the *spina anter. super.*, perforates the inferior border of the abdominal muscles, and supplies the skin of the outer superior part of the thigh; with an *internal*, upon or outside the *art. cruralis*, through the femoral ring to the skin of the anterior superior part of the thigh.

b. *Ram. internus* s. *n. spermaticus externus* [*s. ileo-inguinal*] runs through the femoral ring on the inner side of *v. cruralis*, with an *external* branch which terminates in the inguinal glands over Poupart's ligament and the skin; with an *internal* branch through the inguinal canal upon the spermatic cord (or *lig. uteri rotund.*) into the *tunica vaginalis propria* to *m. cremaster*, *testicle*, *tunica dartos*, and skin of the *scrotum* (or to *mons Veneris* and the anterior extremities of the *labia*).

665. b. The principal branches, femoral.

4. *N. cutaneus femoris anterior externus* [*s. inguino-cutaneus*], arises from the second loop, perforates the *psoas*, passes down upon *m. iliacus* underneath its aponeurosis; behind *art. circumflexa ilei* at the outer extremity of *lig. Poupartii* through a short sheath, here perforates the *fascia cruralis*, and descends on the outer side of the thigh as far as the knee. Connexions: with the two rami of the *genito-cruralis* (plexiform). Branches: to the skin over *trochanter major*, and internally in front.

5. *N. cruralis*, the middle and largest branch of the lumbar

plexus, arises, especially, from the second, third, and fourth lumbar nerves, passes rather obliquely downwards, outwards and forwards, behind *m. psoas*, then before *m. iliacus*, behind *lig. Poupartii* upon the anterior surface of the thigh, where it immediately divides into two principal branches. Situation: in the *fossa iliaca*; in the fossa between *psoas* and *iliacus* covered by the *fascia iliaca* on the external border of the *psoas*; behind the *lig. Poupartii*; separated from the *art. cruralis* by its sheath and the tendon of *psoas*, below the femoral ring. Branches: to *m. psoas* and *iliacus pectineus* [?] and the following:

1. *N. cutaneus femoris anterior internus* comes off at *Poupart's* ligament, and descends as far as the outer surface of the knee. It gives branches to *m. sartorius* and supplies the skin of the outer surface in the centre, and that of the anterior and internal in the lower third of the thigh.
2. *N. cutaneus femoris anterior medius* arises from the anterior and internal principal trunk, descends in the lower third of the thigh outwards, and terminates above and outside the *patella*.
3. *N. patellaris* arises next to the last on the outside, below *lig. Poupartii*, supplies the skin on the internal and anterior part of the lower extremity of the thigh, and turns over the *patella* to the anterior part of the superior extremity of the leg.

By anastomoses between the external cutaneous nerves, loops and superficial plexuses arise upon the inferior part of the *patella*.

4. *Rami musculares* for: *tensor fasciæ* (sometimes [?]), for *vastus externus* (from three to four), *internus* (one), *m. sartorius*, several, superficial and deep, which, perforating the muscle, pass to the skin on the inner side of the knee; for *rectus femoris* and *cruralis*.
5. *Nerv. saphenus magnus*, the principal branch of *n. cruralis*, passes as far as the middle of the thigh on the outer side of *art. cruralis* above the passage of the last through *m. adductor magnus*, and divides into an internal and a larger external branch.
 - a. *Ram. internus* passes over *art. cruralis*, behind *m. sartorius*, then perforates it and passes on the *internal* surface of the knee-joint to the *anterior* of the shin-bone to ramify in a radiating form in the skin over its upper third. A branch passes backwards to the middle of the thigh.
 - b. *Ramus externus* is larger, passes over the *art. cruralis*

downwards and inwards, comes forth, after being more deeply seated, from between *m. gracilis* and *sartor.*, and descends on the internal and anterior part of the leg, with the *ven. saphena*; it supplies the skin of the inner part of the popliteal region, of the calf, of the inner malleolus and back of the foot.

6. *Nervus obturatorius*, arises especially from the fourth lumbar nerve, passes downwards posterior and internal to *m. psoas* with the *vasa obturatoria* close to the lateral parietes of the pelvis, and enters the foramen in the *membrana obturatoria* above the artery, where it divides for the supply of the *nn. obturatorii* [only *externus* and sends a few filaments to the hip-joint].

- a. *Ram. anterior* is larger, passes forth between *adductor brevis* and *longus*, supplies these, the *gracilis*, the skin on the internal anterior region of the middle of the thigh, and, united with *n. cutan. fem. intern.* the inner side of the calf [and knee—hence pains in this region in incipient disease of hip-joint].
- b. *Ram. posterior* perforates, and supplies the *adductor longus* and *brevis*, and ramifies in the *magnus* as far as the knee.

666. IV. The Sacral Nerves, *Nervi sacrales*, (eight pairs).

They arise (except the fifth) side by side from the inferior enlargement of the spinal cord. Their roots descend, almost vertically, in the *canal. spinalis*, inside of which, even, the ganglia of the posterior roots are situated. The trunks of the united roots are therefore longer than those of the lumbar nerves. They divide soon after their exit from the sacral foramina, into their anterior and posterior branches.

- a. The *anterior* branches decrease in thickness from the second to the fifth, pass out through the *foramina sacralia antt.*, but the last between the inferior piece and the cornua of the sacrum unite with *n. sympathicus*, and give branches to *m. pyriformis* and *coccygeus*. The first to the fourth give branches to the plexus in the depth of the pelvis, and form the *plexus ischiadicus* with the fifth lumbar nerve. The fifth unites with the fourth and the coccygeal nerve, and goes directly into the skin of the anal region.
- b. The *posterior* branches are less developed, the third most. They pass forth through the *foram. sacral. posteriora*, unite with each other, with the anterior branches, and with the last lumbar and coccygeal nerves, and pass as the *posterior* cutaneous nerves of the glutæal region; *nn. clunium posteriores* (3)

667.

Plexus sacralis s. ischiadicus,

formed of the first, second and third sacral nerves, and of branches of the fourth and fifth abdominal [lumbar] nerves; is situated in a direction downwards and outwards towards the inferior extremity of the *incisura ischiadica major* before the *m. pyriformis*; before it, the *vasa hypogastrica*, which separate it from the *peritoneum* and *rectum*. It is connected above with the lumbar plexus [by *lumbo-sacral* nerve], in front with the hypogastric plexus; below it continues into the *n. ischiadicus*, and with the smaller portion of the muscular nerves of the *glutæus*, the posterior region of the thigh, and into the pudendal nerves.

1. The secondary branches.

a. *Nn. hæmorrhoidales medii* and *vesicales inferiores*, are three or four twigs of the anterior branches of the third sacral nerves, they give branches to *plexus hypogastricus* (see *n. sympathic.*), pass to the *rectum* and above the *vesiculæ seminales* to the neck of the bladder, in the female as far as the vagina.

b. *Nn. hæmorrhoidales inferiores*, the terminal filaments of the anterior branches of the fourth sacral nerve. This last gives branches to *plex. hypogastricus*, the *prostata*, *vagina*, *m. levator ani* and *coccygeus*.

1. *N. glutæus superior*, arises from the loops of the third and fourth lumbar with the first sacral nerve, passes above *m. pyriformis* with *art. glutæa* through the *incisura ischiad. major*, anastomoses with the ischiadic nerve, and divides immediately into two or three principal branches, the largest of which passes in a curve to the outer part of the thigh, between *glutæus medius* and *minimus*; it supplies the *glutæi* [*g. med.* and *min.*] and skin [?], the *tensor fasciæ*, and in the pelvis, the *pyriformis*.

2. *N. glutæus inferior*, arises from the loops of the fourth and fifth lumbar, and first and second sacral nerves, passes out below *m. pyriform.* with *art. ischiadica* from *incisura major* on the internal surface of *glutæus maximus*; ramifies in it and in the skin, and unites with the ischiadic nerve.

3. *N. cutaneus femoris posterior communis*, arises from the first and second loop of the sacral nerves, passes out under *m. pyriform.* through *incisura major* with *art. ischiadica* and downwards between *tuber ischii* and *trochanter major*, dividing into several branches:

a. *Nn. cutanei clunium inferiores* are reflected around the inferior border of *glutæus maximus*, supplying the skin of *trochanter major* and the lower part of the glutæal region.

- b. *Nn. scrotales* s. *labiales* are reflected beneath the *m. glutæus maximus* inwards, and terminate in the skin of the internal superior part of the scrotum or *labia maj.*, sometimes also in the *perinæum*.
- c. *Nn. cutanei femoris posteriores*, for the skin of the posterior and inner part of the thigh as far as the posterior and outer part of the popliteal region, whence filaments extend downwards to the outer and interior region of the calf.
- 4. *N. pudendus* s. *spermaticus communis* arises (variably) from the flat cord of the associated sacral nerves, immediately passes in the depth between *lig. spinoso-sacrum* and *sacro-ischiadicum* on the inner side of *art. pudenda* under *m. levator ani*, and divides into :
 - a. *Ram. inferior* s. *N. perinæi*, corresponds to the *art. pudenda* (with the exception of *art. dorsalis penis*), passes, above this, from behind forwards, then between *m. obturator intern.* and *membr. obturat.* with a curve upwards, and terminates with a *superficial* branch (with *art. transv. perin.*), taking a course, obliquely inwards and forwards, to the lower part of the scrotum and the penis, with a *deep* branch to the anterior part of *sphincter ani*, to the *bulbo-cavernos.* and *bulbus urethræ* (in the female to *sphincter vaginæ*, the *labia* and *mons Veneris*).
 - b. *Ramus superior* s. *n. dorsalis penis* (*n. clitoridis* of the female), passes in a curve (with *art. pudenda*), at first close to the inner surface of the *tuber ischii*, then upwards between *levator ani* and *obturator internus*, and beneath *symphysis pubis* (surrounded by the veins), upon the dorsum of the penis in the middle line, and more superficial than *art. dorsalis* ; it divides into two branches, the internal deeper of which goes to the glans, the external cutaneous ramifies on the sides of the penis, and forms a plexus which supplies the skin of the three superior fourths of the organ.

The nerve of the *clitoris* is finer and smaller, but takes precisely the same course.

5. *N. hæmorrhoidalis infimus* arises, frequently, from *n. pudendus*, passes, more internally than this, between *lig. tuberoso-* and *spinoso-sacrum*, under the *levator ani*, in the fat, divides and passes to the posterior part of the *sphincter ani* and the neighbouring skin.

6. *N. ischiadicus*, the *largest* nerve of the body, arises from the third and fourth lumbar, and the first, second and third sacral nerves, passes out from the *incisura ischiadica major* below *n. pyriformis*, flattened, descends between *tuber ischii* and *trochanter*

major, close upon the rotator muscles, covered by *glutæus maximus*, directly to the posterior surface of the thigh. It here lies enveloped in fat, and accompanied by no [large] vessel, before the long head of *m. biceps* and before *m. semitendinosus*, then in the fossa between the two; behind *m. adductor magnus*. [Above *gemellus sup.* it gives off a branch which, passing behind the two *gemelli* and *obturator intern.*, is lost in *quadratus femoris*.]

Distribution. At the breadth of three to four fingers above the knee-joint (the commencement of the popliteal space); even before or after its exit from the pelvis it divides into two principal branches. *Branches*; superior: to *mm. biceps, semitendinosus, membranosus, adductor magnus*; inferior: to *caput breve bicipitis*, to the fat of the knee-joint, to the outer side of the patella.

a. *N. peroneus s. fibularis s. popliteus externus*, the smaller external branch, descends on the external side of *biceps*, obliquely outwards through the popliteal region, then behind *condylus extern. femoris* and *tibiæ*, between the tendons of the *biceps* and the outer head of *gastrocnemius*; outwards and rather forwards, behind the superior attachment of *m. solæus* to the *capitulum fibulæ*, where it divides into one of two superficial and deep branches. *Branches*: to *biceps* and *knee-joint* (see *n. ischiadic.*); farther:

α. Posterior cutaneous branches, *rr. cutanei cruris peronæi posteriores*.

1. *N. cutan. medius internus*, descends under the *fascia* in the middle of the posterior surface of the calf as far as the inferior extremity of the leg.
2. *N. cutan. medius externus s. communicans fibularis* passes along the outer half of the calf and the *tendo Achillis*, then under the external malleolus to the back of the foot, supplies the skin on its *outer half*, the dorsal surface of the *outer side* of the fifth, and the collateral surfaces of the fourth and fifth toes; and unites with *n. communicans tibialis* (which see).
3. *N. cutaneus externus*, supplies the skin of the outer border from the superior to the inferior extremity of the leg.

β. The superficial terminal branches of *n. peronæus*.

4. *Ramus superficialis externus s. N. cutaneus dorsi pedis medius*, passes on the outer side of the *fibula*, gives branches to *gastrocnemius extern.*, *peronæus tertius*, *extensor hallucis longus*; betakes itself to the middle of the anterior surface of the leg, perforates the *fascia*, supplies the skin of this part and about the external malleolus; divides dichotomously on

the dorsum of the foot, and supplies with an *internal* arched branch the skin of this region, as far as the root of the great toe ; with an *external* branch the collateral surfaces of the third and fourth toes.

5. *Ramus superficialis internus* s. *N. cutaneus dorsi pedis intern.* supplies the *mm. peronei*, passes over the ankle joint inwards, towards the internal malleolus, supplies the skin on the internal border of the *dorsum pedis* and bifurcates. Its *internal* branch supplies the inner surface of the *great*, and the collateral surfaces of the same and the second toe ; its *external* branch the collateral surfaces of the second and third toes.

γ. The deeper terminal or muscular branch.

6. *N. tibialis anticus* winds round the *capitulum fibulae*, forwards, descends on the anterior surface of *lig. inteross.* outside and before *art. tibialis antica*, between *m. extensor digitor. longus communis*, *hallucis* and *tibialis anticus*, gives branches to these muscles, passes under *lig. cruciatum*, upon the *dorsum pedis*, into the sheath of *extensor halluc.* and bifurcates.
 - a. *Ramus internus*, continuation of the trunk, passes under *art. metatarsæ (pedicæ ?)* directly forwards, between first and second *os metatarsi*, unites with the fifth, and supplies, accordingly, the dorsal side of the collateral surfaces of the first and second toes.
 - b. *Ramus externus* passes transversely outwards, close upon the *tarsus*, under *extens. brevis halluc.* and *digitor. communis*, and supplies them.
- b. *N. tibialis* s. *peroneus internus*, descends as the continuation of *n. ischiadicus*, vertically through the popliteal space, between the heads of the *gastrocnemius*, then on the posterior surface of the *tibia*, covered by *m. soleus*, and on the internal border of *tendo Achillis*, behind and under the internal malleolus, where it bifurcates. Situation : in the *popliteal space*, on the posterior and outer side of *vena poplitea*, covered only by the *fascia* ; as far as *tendon Achillis*, by *mm. gastrocnemius* and *soleus*, on the outer side of *art. tibialis postica* ; behind and below the *malleolus*, covered by the *fascia*, in a sheath with the *vasa tibialia* (and behind them), behind the tendons of *m. tibialis posticus* and *flexor. commun. digit longus*.

Branches : for the posterior part of the knee-joint, for *m. popli-*

tæus, the muscles of the calf, *m. tibialis postic.* and *flexor hallucis longus*. Farther :

1. *N. communicans tibialis s. cutaneus longus* (*s. saphenus externus*), descends behind the popliteal space and the calf, then curves under the *external malleolus* and unites with *n. communic. fibularis*, as :

N. dorsalis extern. digiti 5, on the outer border of the foot and to the fifth toe (see before).

2. *N. cutaneus plantaris* arises in the centre of the leg, perforates the *fascia* on the *tendo Achillis*, and passes to the skin of the heel and the sole.
3. *N. plantaris internus*, arises under *proc. internus calcanei*, passes over *m. abductor hallucis*, and between this and *flex. digit. commun. brevis*, and bifurcates. Its internal smaller branch passes on the inner border of the sole to the great toe, supplying the skin and *mm. flexor* and *abductor brevis*. Its *external* branch bifurcates, supplies the skin, *mm. lumbricales* [only two] and *interossei* [?] and the joints, as well as the collateral plantar surfaces of the first and second, the second and third, the third and fourth toes.
4. *N. plantaris externus*, is stronger, passes forwards between *caro quadrata* and *flexor. digitor. comm. brevis* to the outer border of the foot, gives branches to these muscles, and *abduct. brevis digit. 5*. Its *superficial* branch supplies the collateral surfaces of the fourth and fifth, and the outer surface of the fifth toe. Its *deeper* branch passes in a curve to the *arcus arter. plantaris*, inwards and forwards, and supplies the *adductor halluc. flex. digiti 5*, and *interossei*.

668. V. The Coccygeal Nerves, *Nervi coccygei*, (one or two pairs),

arise from the *conus medullaris* with a single root which descends in the *filium terminale*, enlarges at the point of the sheath of *dura mater*, passes out and descends with two branches on the middle ligament of the sheath to the inferior extremity of the *sacrum*. The *anterior branch* is the larger, passes out between the cornu and the superior part of the first piece of the coccyx, forwards, unites with *n. sympathicus* (see *ganglion coccygeum*) ; and with the anterior branch of the fifth sacral nerve.

The *posterior branch* passes immediately backwards, and unites with the posterior branch of the fifth sacral nerve.

[Nerves of the Lower Extremity from the LUMBAR PLEXUS.

<i>Anterior crural nerve</i>	supplying the <i>flexors</i> of the hip, <i>sartorius</i> , and the <i>extensors</i> of the knee joint.
<i>Obturator nerve</i>	— the <i>obturator extern.</i> , the <i>adductors</i> and <i>gracilis</i> .
LUMBO-SACRAL.	
<i>Superior glutæal</i>	— <i>glutæus med.</i> and <i>min.</i> and <i>tensor vaginæ femoris</i> .
<i>Cutaneous branches</i>	— the skin over these muscles.
SACRAL.	
<i>Internal pudic</i>	— muscles and skin of <i>perineum</i> , and <i>parts</i> of the organs of generation, &c.
<i>Inferior glutæal</i>	— <i>glutæus maximus</i> and skin of pudendal and posterior femoral regions.
<i>Branches</i>	— <i>Viscera</i> in pelvis.
<i>Branches</i>	— <i>obturat. intern.</i> , <i>pyriform.</i> , <i>gemelli</i> , <i>quad. femoris</i> .
Sciatic Nerve.	<i>Muscular branches</i> — the <i>flexors</i> of the knee.
	<i>External poplitæal</i> — the <i>peronæal</i> muscles, the <i>flexor</i> of foot and <i>extensors</i> of toes.
	<i>Internal poplitæal</i> — the <i>extensors</i> of foot and <i>long flexors</i> of toes.
	<i>(posterior tibial)</i>
	<i>Internal plantar</i> — <i>short flexors</i> of toes.
	<i>External plantar</i> — the <i>flex. acc.</i> , <i>interossei</i> , <i>adductor. hallucis</i> , <i>trans. pedis</i> and <i>fl. min. digit.</i>
	<i>Cutaneous branches</i> — the skin over these muscles.]

669.

The Sympathetic Nerve,

Nervus sympathicus s. *gangliosus*,

This is a string (connecting cord) of from twenty-four to twenty-five interrupted *ganglia*, found upon the lateral and anterior surfaces of the vertebral column, before the transverse processes of the vertebræ, which forms *plexuses* on the different organs by means of branches which pass off laterally from the *ganglia*. It receives its roots from the brain, but in great measure from the spinal cord, as filaments pass from each spinal nerve to the corresponding ganglion, remaining here with the already existing plexus, or continuing, after a longer or shorter course, from the connecting cord into the lateral branches. [Filaments also arise within the *ganglia*.] The ganglia correspond, generally, to the intervertebral spaces, and are in close relation, by means of connecting filaments, with all the other ganglia of the body, like a chain. The connecting cords of the two sides are associated before the *os coccyx* in the *ganglion coccygeum*.

A. The ganglionic chain, central portion,
is divided into the cranial, cervical, thoracic, abdominal, and pelvic portions.

670. I. The Cranio-cervical portions, *pars cephalica*.

The cervical portion consists of three (or four) ganglia connected together by means of the trunk, is situated upon the anterior surface of *mm. rectus capit. antic. major* and *longus colli*, surrounded by loose uniting tissue, behind *carotis interna* and *communis*, *v. vertebralis* and *n. vagus* (on their inner side).

The trunk between the ganglia is white, thinner or thicker, sometimes knotty and divided, descends vertically to the second ganglion, behind *art. thyreoid. inferior*, or directly to the third ganglion.

671. 1. *Ganglion cervicale supremum s. magnum* is spindle-shaped, fusiform, flattened, rather concave on the inner surface; gray, even; half to one inch long, one to six lines broad, one to three lines thick; sometimes fissured at the inferior extremity, and constricted (double?). Position: generally before the *proc. transvers.* of the second to the fourth cervical vert., before *mm. rectus cap. antic. major* and *longus capitis*, posterior and internal to *carotis interna*, *n. vagus*, and *hypoglossus*; ten to twelve lines below the *introitus canal. carotici*. It receives its principal roots from the three first cervical nerves, some also from the fourth and fifth. These enter into its posterior side, are reflected, and then pass into the rami and the cord of the cervical portion. The branches are:

a. *Ramus ascendens*, passes off from the superior extremity, and divides into an anterior and posterior branch, which together form the *cranial portion* of the *n. sympathicus*.

1. *N. jugularis (r. posterior)* ascends from the superior posterior part to the *foram. jugulare*, and gives filaments to: *gangl. petrosum glosso-pharyngei*; *gangl. jugulare vagi*; to *nerv. hypoglossus*. The last, generally, enter the *gangl. cervic. supremum* in an isolated manner, and do not properly go to the *hypogloss.*, but come from it.

2. *N. caroticus (ram. anterior)*, ascends on the posterior and internal surface of *carotis interna*, forming delicate *plexuses*, and divides on the first curvature, close beneath *canal caroticus*, into an *external* and *internal* branch, which pass together on the outer and inner side of *carotis*, ascending in the canal to the *plexus cavernosus*. In the canal arise:

- a. *N. carotico-tympanicus inferior*, from the *external* branch, passes through a little canal on the posterior outer wall of *can. carotic.* into the *tympanum* for the *nerv. Jacobsonii* (see *n. glosso-pharyngeus*).
- b. *N. Vidianus profundus* (*s. petrosus prof. major*), passes through *can. Vidianus*, with *n. Vid. superficial.* to the *gangl. Meckelii* (see *trigeminus*), after it has received the superior connecting branches with the *plex. tympanicus*.
N. petrosus profundus minor. This passes out between *can. caroticus* and the osseous *tuba Eustachii*.
- c. Connecting branches with *m. abducens*; commonly, three wind round the second curvature of the *carotis* outwards, and pass into the *sinus cavernosus*, to *nerv. abducens*, where this crosses the *carotis*.

672. *Plexus cavernosus*, is situated below and on the inner side of *carotis*, at its entrance into the *sinus cavernosus*, is gray, perforated by arteries, and gives numerous branches, which form a plexus, partly about the *carotis* and its branches, and partly pass to other nerves. Branches:

1. For *n. oculo-motorius*. A twig passes, constantly, between *n. oculo-motor.* and *ophthalmicus (n. quinti)* through *fissura orbital. super.* to the longer (or shorter) root of *ganglion ciliare*. Others pass close over *n. abducens* to *n. oculo-motorius*.
2. For *n. trigeminus*. They pass over the third curvature of *carotis* from within outwards, and advance, partly into the internal portion of *gangl. Gasseri*, partly into *n. ophthalmicus*. Several *rr. recurrentes* pass backwards to the *tentorium cerebelli*.
3. For *n. abducens*. They pass on the internal inferior side of *n. abducens* below the last curvature of the carotid; sometimes to *n. trochlearis*.
4. For *n. opticus* and *gangl. spheno-palatinum*. Some filaments go on the inner side of *nerv. abducens* from the superior anterior part of *plex. cavernosus*, but only reach as far as the sheath of the optic nerve, and appear to anastomose with filaments of the *gangl. spheno-pal.* (Valentin.)
5. *Ramuli sphenoidales* (four to six) pass inwards to the *dura mater* around the *hypophysis* (but probably not into this), and into the *sinus sphenoidalis*.
6. *Ramuli ad carotidem cerebralem* pass on the inner side of *n. abducens*, on the sigmoidal superior curvature of the *carotis* to *plex. n. mollium*.

b. *Ramu descendens* is the connecting cord of the *n. sympathicus* itself (see above). From it connecting filaments pass off to *n. cardiacus* and *laryngeus superior*.

c. Anterior branches of *ganglion cervicale I*.

1. *Nervi molles* (s. *carotidis externæ*), arise singly or with a common trunk (*truncus n. mollium*) from the anterior surface of the ganglion, are soft, thin, and reddish, descend forwards, entwine round both carotids, and form *plexuses* round all the rami of *carotis externa*.

Plexus nervorum mollium are as numerous as the branches passing off from the *carotis extern.*; also, *pl. thyroideus, lingualis, &c.* Above the point of division of the large arteries they commonly form *ganglia*; thus *ganglion intercaroticum* in the angle between *carotis interna* and *externa*. The following nerves have a distinct share in these plexuses; *n. hypoglossus, vagus, glosso-pharyngeus, facialis, and trigeminus*. From the *plexus facialis* a filament passes, as a soft root, to the *gang. maxillare*; from *pl. maxillar. internus*, with *art. meningea media* to *ganglion oticum*.

2. *N. cardiacus superior* s. *longus*, arises from the inferior extremity of the *ganglion*, or below this even from the trunk, enlarged by the laryngeal branch of the *vagus*; passes on the inner side of *n. sympathicus* before *m. longus colli*, behind *carotis communis*, in front, over *art. thyroidea* (on the right side close to *trachea*, on the left before *œsophagus*), enters the chest behind *art. subclavia*, and passes with the *carotis*, (on the left) and *truncus anonymus* (on the right side) to the *aorta*, in the coats of which it is, partly, lost, sending filaments on to the *posterior cardiac* and *pulmonary* plexus. It unites with: *nn. molles, vagus*, and its *recurrent* branch, and gives filaments to the *thyroid* gland, *m. sterno-hyo-thyroid*, *constrictor pharyng. inferior*. It sometimes forms two *ganglia*.

a. *Gangl. cardiacum superius*, small, close under *art. thyroide. inferior*.

b. *Gangl. cardiacum inferius*, s. *Wrisbergi*, larger, in the thorax (upon the right side, where the nerve is generally stronger).

673. 2. *Ganglion cervicale medium*, roundish, elliptical, smaller than the superior cervical ganglion, is larger in one instance than in another, but almost always present; it is placed on the trunk of *n. sympathicus*, between the *superior* and *inferior* cervical gan-

gion on the *art. thyreoid inf.*, receiving ramuli from the fifth and sixth, or fifth to the seventh cervical nerves, and the principal filaments of *plex. thyreoides inferior* (is not to be confounded with the ganglionic enlargement before the fourth and fifth cervical vertebræ; this is often wanting). Between it and the inferior cervical we find, almost always, small ganglia interposed.

- a. *Plexus thyreoides inferior*, passes from the cervical portion, form *plexuses* around the *art. thy. inf.*, gives branches to the thyroid gland, and receives those of: the *plexus* of the cardiac nerves in the inferior part of the neck, from *n. recurrens*, and the trunk of the *vagus*. In it lies *before* or *behind art. thyreoid. infer.* a *gangl. thyreoides inferius*.
- b. *N. cardiacus medius*, arises from or below the *gangl. c. medium*, passes downwards and inwards behind the *carotis*, form *plexus* around this (forming in the *thorax* the *gangl. cardiac. medium*), and enter along it the posterior cardiac plexus; it unites with: *plex. thyreoid. infer.*, with branches from *gangl. infimum c.* and *n. vagus*.

674. 3. *Ganglion cervicale infimum s. stellatum*, flat, roundish, or three to four cornered, rarely double, sometimes blended with the first thoracic ganglion, lying before the root of *proc. transv.* of the seventh cervical vert., or on the neck of the first rib, higher or lower upon the *art. vertebral*, behind *art. subclavia*. Its roots come from the sixth and seventh, also from fourth, fifth, and eighth cervical nerves. Its branches are:

- a. *N. cardiacus infimus*, half a line thick, passes downwards and inwards, with the trunk of the *vagus*, and then on the *arcus aortæ* to the inferior cardiac plexus; is sometimes wanting upon the right side, forms united with *n. card. medius*, the thick (*crassus*) cardiac nerves. Connexions: with *plex. vertebral.*, *subclav.*, *laryng. infer.* and *vagus*.
- b. Branches (three) for *art. vertebralis*, ascending on this in the *canal. vertebral.*, surrounding it like a *plexus*, and anastomosing with the cervical nerves.
- c. Branches (two) for *art. subclavia*, forming loops about it, and sinking into the first thoracic ganglion.
- d. The trunk of *n. sympath.*, between the lowest cervical and first thoracic ganglion, divides and descends before and behind *art. subclavia*.

675. II. *Pars thoracica n. sympathici.*

The thoracic portion descends along the vertebral column (from

the first to the third ganglion, upon the heads of the ribs, then more externally), through the thorax, and divided, between the external and middle crus of the diaphragm, into the abdomen. Before it is covered by the *pleura*; behind it pass the *vasa* and *nerv. intercost.*; close to that of the right side the *v. azygos*. Its ganglia :

Ganglia thoracica (eleven to twelve) are flat, generally triangular, with the apex directed outwards, and they are applied to the outer side of the trunk. The two first and the twelfth are the most developed, but less so than the cervical ganglia. The first is covered, partly, by *art. subclavia* and *vertebral*. They contain a single or threefold root from the intercostal nerves, and give branches : to the *cardiac*, *pulmonary*, *æso-phageal*, and *aortic plexuses*, for the bodies of the vertebræ and the intercostal spaces. Lastly :

The roots to the *nervi splanchnici*, the visceral branches.

676. III. *Pars lumbalis n. sympathici*.

The lumbar portion descends on the sides of the bodies of the lumbar vertebræ internal to the *m. psoas*, and unites above and below by means of transverse cords with the one of the other side. The trunk is single as well as double and triple. Its ganglia :

Ganglia lumbalia (four to five) are small, flat, and elongated, frequently blending one with another, so that only two or three appear to be present (as in the neck); grayish-red, like the rest of the *ganglia*, and lying on the left behind *aorta abdominalis*, on the right behind *v. cava*. Their single, double, triple or five-fold roots, from the anterior branches of the lumbar nerves, are very long, and pass into them, around the bodies of the vertebræ, under *m. psoas*. Branches :

To *aorta abdominalis*, *art. lumbales*, *hypogastrica*, and the *plexuses* of the same names, *n. renalis infer.*, *poster.*, and filaments between *n. renalis* and *spermaticus*.

677. IV. *Pars sacralis et coccygeus*.

The pelvic portion descends, divided into two larger filaments, on the anterior surface of the sacrum, to the inner side of *foram. sacralia anteriora*. Its trunk is very delicate, approaches more and more the farther it descends to that of the other side, and unites by means of transverse filaments with it, and the plexus about the *art. sacralis media*, and terminates with the *gangl. coccygeum*. Its ganglia :

Ganglia sacralia (four to five, or six) are very variable in situation, shape, and number, the superior generally the thicker; they lie close to the exit of the anterior roots of the sacral nerves, from which they receive two thick roots. Branches:

To *art. hypogastrica* and their branches, *rectum* and pelvic *plexus*.

Plexus sacralis medius commences even upon the fourth lumbar vertebra, descends on the anterior surface of the sacrum, becomes larger as far as the fourth piece of the *sacrum*, and forms four to five ganglionic circles about the *art. sacralis media*, becomes more delicate on the *coccyx*, and terminates in the

678.

Ganglion coccygeum.

An azygos, small ganglion, in which the most external filaments of the *n. sympathici* of the two sides blend together. It is situated upon the anterior surface of the *coccyx*, unites with the coccygeal nerves, and gives several minute filaments to the apex of the *os coccyx*.

B. Visceral branches and plexuses.

679.

a. *Rami splanchnici* (s. *pars thoracica*).

1. *Nerv. splanchnicus supremus*, is not constant, it arises from the *cardiac plexus*, and receives roots from the first to the sixth thoracic ganglia. Its course varies, sinking into the *vagus*, or with the *aorta* into the abdomen to the *plexus mesaraicus superior* and *renalis*.

2. *N. splanchnicus major*, arises with many roots from the fifth to the eleventh or all the thoracic ganglia, descends along the vertebral bodies, becomes flattened, passes between the external or internal and middle crus of the diaphragm (or through *hiatus aortic.*) in great measure to the *gang. semilunare* of its own side. The right sends a portion of its fibres, to the left, towards the spleen; the left towards the right, so that they cross.

3. *N. splanchnicus minor*, arises from the eleventh or twelfth thoracic ganglion or higher, passes *outwards* close to 2, sometimes united with it, into the lower part of *plex. cæliacus*, often also into *plex. renalis*.

4. *N. splanchnicus inferior* s. *renalis posterior*, arises from the twelfth thoracic ganglion, anastomoses with 3, and passes to *plex. cæliac.*, *renalis*, and *supra-renalis*.

The *nn. splanchnici* are *white*, the *plexus*, into which they enter *gray*.

680.

b. Plexuses in the abdomen.

I. *Plexus solaris* (*cæliaci* s. *mesenterici*) comprehends the great plexus of nerves on the aorta, from the origin of *art. cæliaca* and *mesaraica super.* as far as the commencement of the renal arteries, lying behind the peritoneum, deeply, behind the *regio epigastrica*, and forming very large ganglia, from which numerous branches, interlacing with each other, pass off, and which anastomose with *n. vagus*, *phrenicus*, with other branches of the *sympathicus*, a less number with the lumbar nerves. The principal mass of them forms the two :

1. *Ganglia semilunaria* (s. *magna cæliaca* s. *cerebrum abdominale*), two reddish, bridge-like masses of ganglion, which are situated on the inner sides of the supra-renal capsules.

Into these ganglia the *white nn. splanchnici major* and *minor* betake themselves ; from them *gray* branches pass out, as :

1. *Rami phrenici*, uniting with posterior branches of *n. phrenicus* and forming *plexus* about the *artt. phrenicæ inferr.* on the right and left, entering into the fleshy portion of the diaphragm, and connecting themselves with the hepatic and suprarenal *plexus*.
2. *Rami suprarenales* (eight to sixteen) form, particularly upon the posterior surface of the suprarenal capsules, *plexus suprarenales*, which are connected with *n. phrenicus*, *vagus*, and with the *renal plexus*.
3. *Rami hepatici*, arise from the two large ganglia and that part of the *plexus solaris* which lies transversely over the *art. hepatica* before the *aorta* ; and forms :
 - a. *Plexus arteriosus hepaticus* s. *dexter*, on the hepatic artery and *ductus hepaticus* within the liver ; where it anastomoses with the
 - b. *Plexus venosus*. From this plexuses go to the gall bladder (also from a), *ductus cysticus*, and *choledochus*, which are in connexion with those of the *pancreas*, *duodenum*, and stomach.
4. *Rami gastrici* (white) form, especially upon the *art. coronar. ventric. sinistra*, a plexus (*plex. curvatur. minor.*), anastomoses with the branches of *n. vagus* (which see) lying before it, *pancreatic*, *splenic*, and *hepatic* plexuses ; forming a coronet around the *port. pylorica*.
5. *Rami lienales*, forming the *plex. lienalis* on the splenic

artery for the spleen, and giving branches to the *pancreas* and *fundus ventriculi*.

2. *Plexus mesentericus superior*, a dense plexus of whitish-gray nerves at the origin of *art. mesent. super.*, contains on the left side a large ganglion, which is connected with *gangl. celiacum*. Before it lies the pancreas, and it receives the *plex. pancreaticus*, as well as the intestines to which the branches of *art. mesent. sup.* go, supporting the *plexus*.

II. *Plexus intermesentericus aortæ* (s. *aorticus abdominalis*), lies between *art. mesenterica superior* and *inferior*, forms ganglia, and unites with the *mesenteric, renal, inferior caval* and *spermatic plexus*, and sends branches to the *sciatic* and *vesical plexus*.

III. *Plexus mesentericus inferior*, accompanies the arteries of the same name and its branches; unites in the meso-rectum with the *sciatic plexus*.

IV. *Plexus renales*, are situated before and behind the renal vessels; are superior, middle, and inferior, forming small ganglia, and are connected with the principal ganglia (see above). In the kidneys the nerves pass with the arteries, give filaments to the renal *calyces*, and twine around the straight urinary *canaliculi*.

V. *Plexus venæ cavæ inferiores*, are but slightly developed, arise especially from *pl. intermesentericus*, connected with *renal, spermatic*, and *hepatic plexus*.

681.

C. The Pelvic Plexus.

I. *Plexus divisionis aortæ abdominalis*, a superior and inferior. The superior lies under the origin of *art. mesenterica inferior*, passing a little to the left; its right portion passes upon *art. hypogastric. dexter*, the left on the *art. hæmorrh. intern.* to the *pl. hæmorrh. intern.* The inferior is more delicate, lies between the two *art. iliacæ*, and goes into the *plex. hypogastrici*.

II. *Plexus hæmorrhoidalis superior* s. *S. romani*, lies between the two layers of the superior (sigmoid flexure) meso-rectum, is in connexion with the nerves of the *vas deferens*, and especially of the left ureter.

III. *Plexus hypogastrici*, a superior azygos and two inferior lateral.

1. *Plexus h. impar*, goes on the right side of the *art. iliaca*, passing off from the plexus at the place of division of the aorta, and enters right and left the

2. *Plexus h. laterales*. These descend on the *artt. hypogastr.*; form long plexuses, and are surrounded by a ligamentous mass. They are in connexion, below, with

IV. *Plexus hæmorrhoidales inferiores*, a right and a left, connected with the superior plexus of the rectum, receiving branches from the sacral nerves.

V. *Plexus vesicales*, ascend partly at the sides of the urinary bladder, partly horizontally forwards to the *collum vesicæ* and to the prostata (*plex. prostatici*). Filaments pass off from it to the *vesiculæ seminales*, *vasa deferentia*, and form *plex. spermatici*, which are connected above with the *renal plexus*, and continue into the *plexus testicularis*.

VI. *Plexus cavernosi*, arise especially in the *pl. prostatici* and from branches of the sacral nerves, perforate the fibrous mass about *isthmus* and *bulbus urethræ*, and partly cross, as the one enters into the right, the other into the left spongy body.

In the female, instead of branches for prostate, vas deferens, &c., there are corresponding filaments for *uterus* and *vagina*, *ovarium* and *tuba*.

The posterior and lateral *plexus uterini* arise, generally, from *plex. hypogastr.*, the anterior on the contrary, generally, from the anterior branches of the third and fourth sacral nerves. They entwine about the *veins* and enter into the substance of the uterus.

TOPOGRAPHICAL ANATOMY.

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TOPOGRAPHICAL SURVEY OF THE MORE IMPORTANT REGIONS OF THE BODY.

The Head.

682. 1. *Regio occipito-frontalis*, comprehends the cranial vault, above a line between *protuberantia occipitalis*, *proc. mastoideus*, and root of the nose. Thickness of section : $=\frac{1}{2}$ ". Composition: 1. External skin (thick, and covered with hair). 2. Very thick fibro-cellular tissue containing fat, with superficial vessels and nerves. 3. *M. epicranius* with the galea. 4. Loose fibro-cellular tissue. 5. *Pericranium* (firmly attached to the sutures by *vasa emissaria* and prolongations of the *dura mater*). 6. Bones (strongest in front in the central line, where is *crista frontalis*). 7. *Dura mater*—with *sinus longitudinalis* in the middle line—*torcular Herophili* at the *tuber occipitale*,—(*sinus lateralis* thence to the inferior posterior angle of the parietal bones). 8. *Arachnoidea*, *pia*, *cerebrum*.

683. 2. *Regio temporalis*, temples, is bounded, anteriorly, by *proc. orbital.* of frontal bone; behind, by the root of *proc. zygomatic.* and *meatus auditorius*; below, by *zygomatic arch*; above, by *linea temporalis* (*semicircular*).

Thickness : $= 12''$ (before and below); $= 6''$ (above and behind.) Parts: 1. Skin (behind beset with hair). 2. Fibro-cellular tissue containing fat, with *art. temporalis*, which divides into frontal and parietal branches at a distance of $15''$ above the zygoma, $4''$ from the external auditory meatus. 3. *M. attollens auriculæ* and *fasc. superficialis*. 4. Loose fibro-cellular tissue. 5. *Fascia temporalis*, between the two layers of which below, a triangular space with fat and *art. temporal. med.* 6. *M. temporalis*; anteriorly *fat*, *vasa et nerva temporal. profundi*. 7. *Periosteum* and bones,—*pars squamosa temporal.*, *os parietal.*, *frontal.*, *ala magna sphenoid.*, *os zygomatic.* 8. *Art. meningea media*; two fingers' breadth removed (and above) from *proc. orbitalis oss. zygomat.* 9. *Dura mater*, &c.

684. 3. *Aural region* (see *Organon auditus*).

685. 4. *Regio-mastoidea*, is bounded, in front, by the groove between the cartilage of the ear and *proc. mastoid.*; behind and above, by the curved line at which the growth of hair terminates:

below, by the apex of *proc. mastoid.* Parts : 1. Closely-applied external skin and fatless fibro-cellular tissue. 2. *M. retrahens auriculæ, occipital., sterno-mastoid.,* below the last *m. splenius.* 3. The anterior (*auricular*) vessels, nerves, and lymphatic glands in the groove behind the ear, below *m. retrahens* ; behind, below the skin, *vasa et. nn. mastoidei.* 4. Periosteum and bones—*pars mastoid.* of temporal bone, the posterior inferior angle of parietal, and a little way from occipital bone ; *foram. mastoid., sulcus lateralis* (a small portion) ; *sutur. mastoid. and squamosa ; cellul. mastoideæ.* 5. *Dura mater* with (a portion of) the *sinus lateralis,* and *tentor. cerebelli.*

In the new-born infant—the posterior lateral fontanelle.

[*Dissection.* 1. An incision from the *root of the nose* to the *external occipital protuberance,* in the middle line. 2. In front, an incision from the *root of the nose* extending outwards along the eyebrows to the *anterior extremity* of the *zygoma.* 3. Behind, an incision from the *external occipital protuberance* transversely outwards to the *apex* of the *proc. mastoideus.* The section should be carried through the skin and subjacent fibro-cellular tissue, which are then to be reflected outwards towards the ear, *with very great care.* TRANS.]

686. 5. Nasal region, *Reg. nasalis.*

Interior of the nose. The opening of the lacrymal canal—surrounded by a fold of mucous membrane—lies behind a projection of the *proc. nasalis* of the upper jaw, an inch behind the anterior nasal openings, on the external nasal wall. The inferior turbinate bone is distant two lines from the floor of the nasal cavity. [This varies considerably.]

The opening of the Eustachian tube is found in the middle of the side wall of the posterior nasal opening, equally as far removed from the anterior, as the incisor teeth from the *uvula.*

687. 6. The Mouth, *Cavitas oris.*

(See before, “Cavities of the Face.”)

a. Arch of the palate. Parts : 1. Mucous membrane (firmly connected to a fibrous cellular tissue) with *nn. palatini posterr.* 2. *Vasa et nn. palatini medii* at the internal part of the alveolus. 3. *Vasa et nn. alveolares* behind and *infraorbitales* before, on the external part of the alveolus. 4. Palate and superior maxillary bones.

b. Soft palate—*velum pendulum palati*—extended transversely across, behind the arch of the palate, four-sided, five lines high, is on both sides covered with mucous membrane which anteriorly

passes upon the vault of the palate, behind upon the *choanæ*, is bounded at the sides by the palate, and terminates in the palatine arches; in the centre of the inferior surface—the uvula. Parts: from before backwards: 1. Anterior mucous membrane. 2. Layer of mucous glands. 3. Fibrous fascia of *mm. tensores palati* with the insertions of *glosso-* and *pharyngo-palatini*. 4. *Levatores palati*. 5. Layer of glands with *azygos [levatores] uvulæ*. 6. Posterior mucous membrane.

c. Tonsil glands, *reg. tonsillaris*, lie between the palatine arches, assist in forming the *isthmus faucium*, and bounded externally by the *carotis interna*, between the great cornua of the hyoid bone and the angle of the lower jaw. Parts: from within outwards: 1. Oral mucous membrane. 2. *M. Glosso-palatin.* before, *pharyngo-palat.* behind the tonsils. 3. Tonsil with *circul. nervos. tonsillar.* (from *glosso-pharyng.* and *gangl. cervic. super.*). 4. *Constrict. pharyng. super.* externally. 5. Fibro-cellular tissue, nerves. 6. *Plexus venos. pharyng.* 7. *Carotis interna*, eight to ten lines behind and external to the tonsils.

The lymphatics pass into the submaxillary glands [lymphatic].

[Dissection. The pharynx and upper portion of the œsophagus, the larynx and upper rings of the trachea with the surrounding soft parts, the bones of the face, and the anterior half of those of the cranium, are to be removed from the subject. The section of the bones of the *basis cranii* must be made posterior to the roots of the styloid processes of the temporal bones, and through the basilar portion of the occipital, between the origins of the superior and middle constrictor muscles of the pharynx, before, and the insertion of the rectus anticus major muscle, behind. After dissecting the pharyngeal muscles by removing the cellular tissue about them, a vertical division of them should be made through the raphe in the middle line behind. The posterior wall of the pharynx being now turned aside, the parts described under 5. and 6., a, b, c, may be examined after inspection and removal of the mucous membrane. TRANS.]

d. Malar region, *reg. malaris*. Over the malar bone the skin is very delicate and rich in blood-vessels; under it fibres *orbicul. palpebr.*; under these the *zygomatichi*; behind, *art. transv. faciei*; below, *rami zygomat. n. facialis*—*Pars masseterica*. 1. Skin and much fat. 2. The anterior border of parotis and *rami buccales n. facialis*, *ductus Stenonianus*, behind from 8 to 9", in front 4" below the zygomatic bone (with *art. transv. fac.* on its superior margin), its opening in the region of the first and second molar teeth, 4" before the *masseter m.* 3. *M. masseter*. 4. Lower jaw; in the *incisura sigmoid*: the deep vessels and nerves of the

masseter. 5. Below, *n. lingualis*, *ram. mylohyoid.*, *n. dental. infer.*, *m. pterygoid. internus*; above, between the last and *maxilla super.*: *art. maxillar. intern.*, *nn. dental. infer.* and *temporal. superfic.*, *lig. laterale internum*, which separates the preceding from *ram. lingualis n. trigemini*.

[*Dissection*. 1. Carry an incision through the skin, only, from the inner angle of the eyelids along the lower border of the orbit to the outer angle of the lids, thence parallel with the zygoma to its temporal root. 2. An incision from the inner angle of the eyelids to the commissure of the lip, then to the anterior border of the masseter muscle upon the inferior maxillary bone, and thence parallel with the lower edge of the horizontal ramus of this bone to its angle. Reflect the skin towards the *sterno-cleido-mast. m.*, and dissect the parts 1, 2, and 3.

Dissect away *carefully* the parotid gland, leaving it attached by its duct.

Now, saw through the temporal root of the zygoma and the malar bone, divide the fasciæ attached to the zygoma above, and reflect it, together with the masseter muscle, carefully, downwards. The parts, 4., will be exposed, the vessels and nerves close to the posterior border of the temporal muscle. Detach the *masseter* from its insertion, and leave it suspended by its nerve. The insertion of the temporal muscle (the coronoid process of the lower jaw) is now to be sawn through, and, with the muscle, turned upwards. The pterygoid muscles are exposed, and the parts, 5., may be dissected. Two incisions are required to remove the coronoid process; one, vertical, parallel with the posterior border of the ascending ramus, and passing through the centre of the incisura sigmoidalis; the other, transverse, and parallel with the border of the alveolus. The two incisions should meet in about the centre of the ascending ramus. TRANS.]

Pars intermaxillaris—the anterior portion of the cheek; between the upper and lower jaws.

e. Floor of the mouth. The tongue with the *frenulum*, on the sides of which, close beneath the tongue the openings of the *ductus Wharton.*, at the sides of the tongue *artt. raninæ*, and more externally *venæ raninæ*. *Mm. mylohyoid.* shuts in the cavity of the mouth; below it the anterior belly of *biventer*, the skin.

[*Dissection*. To examine these parts and their relations accurately, it is necessary, after removing the skin and displaying the soft parts, to make a vertical section of the lower jaw, on the *outer* side of, *not through*, the symphysis; in fact, between the lower *incisor* teeth and first *cuspidatus*. Then, dividing the mucous membrane of the mouth at its attachment to the lower jaw, the tongue may be drawn forwards, and the anatomy of this region studied. A bristle may be passed through the duet (Wharton's) of the submaxillary gland. The openings of the sublingual glands by the sides of the tongue should also be examined. TRANS.]

688. 7. Cavity of the Gullet (s. Pharynx).

The entrance to the larynx lies in the anterior part of the pharynx, below the *isthmus faucium*.

[Dissection: see under 6. above, after c. TRANS.]

639. 8. Orbital region, *regio orbitalis*.

a. Eyebrows. About the inner third of the superior margin of the orbit the *n. frontalis* passes out, besides the artery.

b. Eyelids. 1. Skin (very delicate). 2. Loose fatless areolar tissue (which becomes easily infiltrated with serum). 3. *M. orbicular. palpbr.* 4. *Artt. palpebrales*. 5. *Tarsus* and *lig. latum palpbr.*; at the border of the orbital margin areolar tissue containing fat. 6. Conjunctiva.

At the internal angle of the eyelid: 1. Most delicate skin. 2. Venous plexus. 3. *Lig. palpebr. intern.* 4. Lacrymal sac, which is separated externally by a fibrous layer from the *caruncula*, below the last, and rather externally, the thin roof of the *antrum Highmori*, and the origin of *m. obliq. inferior*.

690. 9. Zygomatic fossa, *Fossa zygomatica*,

below the temples, above the *masseter*, external to the orbits, internal to the *parotis*. The superficial portion is connected with the deep (*fossa spheno-maxillaris*) by *fissura pterygo-maxillaris*; that with the *orbita* by *fiss. orbitalis inferior*. It is formed by the:

a. Sphenoid; b. posterior part of sup. maxillary; c. palate; d. condyle of infer. maxillary; e. a portion of the temporal; and f. ethmoid bone.

Parts; below the zygoma and the insertion of *m. temporalis*: 1. *Vasa temporalia masseteric.* 2. *M. Pterygoid extern.* with *art. maxillar. intern.* between its two portions, and *plex. ven. pterygoid.* 3. Below the insertion of *m. pteryg. extern.* internally *n. lingualis*, in the centre *n. dental. infer.*, externally *temporal superficialis*. In the *fossa spheno-maxillaris* from above to below; (*v. ophthalmica*, *n. ophthalmic.*, *oculomotor.*, *pathetic.*, *abducens* in the *fissura. orbit. superior*); *n. maxillar. super.* from behind forwards; *ganglion Meckelii* on the outer side of *foram. spheno-palatinum*.

[Dissection. As described in the second part, under b, d. TRANS.]

691. 10. Parotid region, *Regio parotidea*,

is bounded, anteriorly, by the posterior border of *ram. maxillar. infer.*; behind, by *proc. mastoid.* and *meatus auditor. extern.*; above, by *zygoma*; below, by the angle of the lower jaw, and a

horizontal line backwards; internally, by *proc. styloideus*, *lig. stylo-maxillar.*,—*hyoideum*. The parotis occupies nearly the whole of this space, and is all round enclosed in fascia. Parts from without inwards: 1. Skin, slightly hairy (behind the beard of the cheek). 2. Close areolar tissue, having little fat, with branches of *n. auricular*, from *plex. cervicalis*. 3. Lymphatic glands. 4. Parotis; from it upwards: *art.*, *ven. temp.*, *rr. temporal. n. maxill. infer.*; behind: *art. auricular, post.*, and *rr. auricul. n. facialis*. and *plexus cervical*. Inside the parotis: 1. behind, *n. facialis*, 6''' deep; in front its branches $\frac{1}{2}$ ''' deep. 2. *V. parotideæ*. 3. deeper, *carotis externa*, close to the *proc. styloid*.

[Dissection. As described in the first part, under 6, d. TRANS.]

The Trunk.

692. I. The Neck. Anterior cervical region.

a. Supra hyoideal, *reg. supra-hyoidea*, lies between lower jaw and hyoid bone, forms the floor of the mouth.

In the middle line (submental region) lie: 1. skin (in the male hairy) with a thicker or thinner layer of fat. 2. *Mm. platysmam.* with superficial nerves of the *plex. cervical*. and branches of *art. mentalis*. 3. *Ventr. anter. m. digastric*. 4. Deep branches of *art. submentalis*. 5. *Mm. mylohyoidei*. 6. *Mm. geniohyoidei*. 7. *Genio-glossi*. 8. In front and above: *glandula sublingual.*, with *ductus Whartonian*. and the mucous membrane of the mouth; below and behind, the tongue. Laterally, we find over the *m. platysmam.* the following parts: 1. Layer of *fasc. cervical*. 2. Plexus of *art.* and *ven. submental.* (*facialis*), the *vasa lymphat. facialis*, the *n. mylo-hyoid. (dental. infer.)*, branches of *facialis* and superficial branches of *plexus cervicalis*; between them *gland. submaxillar.* and lymphatic glands. 3. *M. mylohyoideus*. 4. Above and before, *gland. sublingual.*, *duct. Wharton.* (above), *n. lingual.* and *art. sublingual.* (below the glands), then beneath the mucous membrane below and behind: 1. *N. hypogloss.* and *ven. lingual.* close to the great cornua of the hyoid bone. 2. *M. stylo-, hyoglossus*. 3. *Art. lingual.* and *n. glosso-pharyngeus* and tongue.

Ven. facialis passes upon the external, *art. facialis* on the internal side of the *gland. submaxillaris*; *art. submental.* below it on the inferior border of the lower jaw; *n. mylohyoideus* still deeper.

b. Infrahyoideal region, *reg. infrahyoidea*. s. *interstitium jugulare*, a triangle the base of which is formed by the *os hyoides*, the

sides by the internal borders of the *musculi sterno-mastoidei*, and the apex by the first piece of the sternum.

1. The central portion consists, above, of the *reg. laryngea* (larynx); the centre, of the *reg. thyreoidea* (thyroid cartilage and thy. gland); below, of the *fossa supra-sternalis* s. *jugulum*, tracheal fossa.

2. Superior lateral portion, *trigonum cervicale superius*, is a triangular fossa, bounded, above, by the posterior belly of *digastricus*, in front, by the superior belly of *omohyoideus*, behind, by the anterior border of *sterno-mastoid.*, and above passing into the *reg. parotidea*. Below lies the *sterno-mast.*, close to and before the *trachea*.

Position of the parts: 1. Skin and loose fibro-cellular tissue, with little fat. 2. Above, *fascia cervicalis* and *mm. platysmam.*; below, in the *jugulum*, a space between the anterior and middle layer of the *fasc. cervicalis*, which sends a process externally into the *reg. supraclavicularis* behind the *m. sterno-mast.*, and contains in the middle line a descending branch of *ven. thyreoid. inf.* (frequently); some lymphatic glands; laterally, the *ven. jugularis anterior*. 3. *Mm. sterno-hyoidei*, above, *m. omohyoideus*. 4. *Mm. thyreo-hyoidei*, branches of *n. hypogloss.* and *mm. sterno-thyreoidei*. 5. Thyroid gland, with the deep layer of *fasc. cervical.*, which is attached to the posterior surface of the sternum and larynx. 6. *Plexus venosus thyreoidus*, and, near the sternum, *v. subclavia sinistra* and *truncus anonymus* (but the last rests entirely beneath this region, as it ascends obliquely from left to right). In the angle between the two: 7. The trachea. 8. Pharynx above; below and to the right, *n. recurrens dexter*; below and to the left, *œsophagus*, and on its anterior surface, *n. recurrens sinistra*, and a transverse branch of *art. thyreoid. inf.* 9. Loose fibro-cellular tissue; under that *mm. longi colli*, and the fifth to the seventh cervical vertebræ.

In the *trigonum cervicale superius*; 1. The skin and thin layer of fibro-cellular tissue. 2. *M. platysmam.* 3. *Nn. cervicale superfic.*, and behind *n. auricularis* (s. *plex. cervic.*). 4. *Ven. jugular. externa*. 5. *M. digastric.* and *stylohyoid.* 6. Lymphatic glands, surrounded with venous plexuses. 7. *N. hypoglossus*, *carotis externa*, which is to be felt in the inferior angle of the *trigonum*. Farther inwards and backwards, *carotis interna* (which see), with the parts surrounding it.

693. Lateral surfaces of the Neck, *Reg. supraclavicularis*.

1. *Reg. sterno-mastoidea*. The *sterno-cleido-mast.* is covered by a loose fibro-cellular tissue, in which the *ven. jugular. extern.* descends from before backwards. It covers:

a. Below (the *m. omohyoideus*): 1. Loose fibro-cellular tissue, wherein is a branch of *ven. jugul. extern.* (anter.) 2. The deep layer of *fasc. cervical.* and *m. omohyoideus*. 3. The external border of *m. sterno-hyoid.*, and *-thyreoideus*. 4. The junction of *vv. jugular. intern.* and *extern.* behind *articul. sterno-cleidoidea* (in the angle the *duct. thoracicus* opens). 5. *N. phrenicus* outside (close to *scalenus antic. m.*), 1" distant from *n. vagus* (close to *carotis commun.*); between the two, *n. sympathicus*. 6. Right, the superior extremity of *truncus anonymus* (*carotis* and *art. subclav. dextra*); left, *carotis comm.*, *art. subclav. sinistra*. 7. Right; *n. recurrens*; left, *ductus thorac.*, the superior extremity of the pleura. 8. *M. longus colli* and vertebral column. The *carotis* lies 1" removed from the anterior border of *m. sterno-cleido-mast.*; the right rather nearer.

b. Above (between *omohyoid.* and *splenius*): 1. *Plex. cervical.* 2. *Art. cervical. ascend.*, *m. rect. antic. cap. magn.*, *scaleni*, *levat. scapul.*, *splenius colli*. 3. *Proc. transversi* and *art. vertebralis*. Quite above, *splenius capitis*, &c.

2. *Trigonum cervicale inferius*, supraclavicular fossa, a triangle, the base of which is formed by the claviculæ (the first rib), the sides by the anterior border of *m. cucullaris* and the posterior of *sterno-cleido-mast.*, and which is divided by the post. belly of *m. omohyoideus* into an inferior smaller, and a superior larger triangle.

Position of the parts: 1. Skin, *m. platysmam*. 2. Before, *v. jugular. extern.*; above, *nn. subcutan. colli, accessor. Willisii*. 3. *M. omohyoid.* and the deep layer of *fasc. cervicalis*. 4. *Art. transversa colli*, *supraclavicular.*, *ven. subclavia* (between the first rib and clavicle). 5. In front, *scalenus anticus* (on the internal border of which *n. phrenicus*); behind, *scalenus med.* (and *post.*); between the two, above and outside the origin of *plex. brachialis*; below and within, *art. subclavia*, upon the first rib, close to the tubercle, separated by *scalenus antic.* from *ven. subclavia*. External to the *scaleni* the artery lies close behind the vein, in the direction of *m. omohyoid.* 6. The transverse processes of the cervical vertebræ, *mm. intertransvers.*, *art. profund. cervic.* and *vertebralis*.

Posterior surface of the neck, nape, *cervix*.

[Dissection. 1. An incision should be made in the middle line, through the skin only, from the chin to the sternum. 2. From the mastoid process to the acromion. 3. From the mastoid process to the centre of the upper border of the sternum.

Two triangular flaps of skin are thus formed, attached by their bases, the one, above, to the horizontal ramus of the lower jaw; the other, below, to the

clavicle. These are to be reflected upwards and downwards. The *platysma myoides* is to be dissected, the course of the external jugular vein examined, and the muscle divided transversely and reflected. The parts above described occupying the various regions, the boundaries of which should be accurately defined, may be now exposed and dissected in succession. TRANS.]

694.

Chest, *Thorax*.

1. *Reg. sternalis*. a. Skin thick, in the male hairy, in the central line firmly attached. b. fibro-cellular tissue, with the tendons of *sterno-mastoid.*, *pectorales*, *rect. abdom.* c. *sternum*: above, *lig. interclaviculare*. d. *M. triangular. sterni*. e. *Mediastina antica*; at the inferior part of the pericardium; above the thymus, *ven. anonyma*.

2. *Reg. mamillar*, beneath the *claviculae*, on the sides of the sternum. Parts: 1. Very delicate skin, especially on the nipple. 2. Fibro-cellular tissue with much fat, in which, above, *nn. claviculares*, mammary arteries and nerves. 3. Mammary gland, with branches of *vasa mammar. interna* and *thoracica*. 4. Loose fibro-cellular tissue. 5. *M. pectoral. major, minor, serratus magnus*. 6. Ribs, intercostal muscles.

3. *Reg. costalis*, costal region. a. Before the ribs, on the superior half of the thorax; behind the shoulder: 1. Skin and thick fibro-cellular tissue. 2. *M. trapezius, latiss. dorsi*. 3. *Rhomboideus*. 4. Above, *m. serratus postic. sup.* 5. Ribs.

On the inferior half: skin, fibro-cellular tissue, branches of *nn.* and *vasa intercost.* Then: 1. *M. rect. abdom.* (in its sheath), *obliq. extern.*, *serratus magn.*, and costal portion of *latissim. dorsi*. 2. Ribs.

b. Between the ribs (*spatium intercostale*): 1. *Mm. intercostales externi*. 2. *Nervi et vasa intercost.* (on the inferior border, of *angulus costæ*, also at the superior border of each rib). 3. *Mm. intercost. intern.*

c. Behind the ribs: 1. Fibro-cellular tissue (and *mm. infracostales*). 2. *Vasa mammar. interna*, above, two lines from the border of the sternum, below, before *m. triangular. sterni*. 3. Pleura. (The chest should not be opened upon the right side below the fourth, upon the left below the third intercostal space (reckoning from below), if it is wished to avoid injury to the diaphragm).

4. *Regio dorsalis*, dorsal region.

695.

Cavity of the Thorax.

1. *Regio mediastini*, is bounded in *front* by the sternum, *behind* by the vertebræ, *above* by the neck, *below* by the diaphragm, *right*

and *left* by pleura and the lungs. Directed towards the left and downwards, this space is broad above, and especially below, in the centre very narrow, also X-shaped. In the centre at the posterior third lie the roots of the lungs.

a. Inferior half corresponds to the inferior of the sternum. Parts : 1. Loose, fibro-cellular containing adipose tissue. 2. Anterior part of the pericardium. 3. Heart, origin of the great arteries, termination of *ven. cava super.* 4. *Vv. pulmonales* ; and post. part of pericardium. 5. Lymphatic glands and œsophagus (in the central line) surrounded by *plex. nerv. œsophag.* 6. *Aorta descend.* to the left ; *ven. azygos* to the right ; *duct. thorac.* in the centre and behind. 7. Fibro-cellular containing adipose tissue, in which are *nn. splanchnici, artt.* and *vv. intercostales*. 8. Dorsal vertebræ.

b. Superior half, behind the superior half of the sternum. Parts : 1. Loose fibro-cellular tissue, containing adipose (thymus gland) with small branches of mammary artery. 2. Above : *v. subclavia sinistra* ; most superior part of the pericardium, below. 3. *Truncus anonym.* and *v. cava superior*, in front ; termination of *art. pulmonalis*, *lig. arteriosum*, *arcus aortæ* (with *n. recurrens*) ; *carotis* and *art. subclavia sinistra* (with *n. vagus* and *phrenicus*) to the left ; curve of *ven. azygos* (with *n. vagus* and *phrenic.*) to the right. 4. In the middle line : termination of the *trachea* (left *n. recurrens*) ; under that a rhombic space between the two *bronchi* and *rami art. pulmonal.* ; in which are lymphatic glands. 5. *Æsophagus*, behind *bronchus sinistra*. 6. *Duct. thoracic.* behind the œsophagus. 7. Loose *fibro-cellular tissue* with the superior intercostal vessels. 8. Extremity of *m. long. colli*. 9. *Dors. vert.*

c. Roots of the lungs, above the centre and in the posterior third. Parts : 1. The *pulmonary veins*, two on a side. 2. *Ramus art. pulmonal.* 3. *Bronchus*, covered before by *plex. pulmonal. anter.*, behind by *n. vagus* and *plex. pulmon. posterior*. They divide the anterior from the posterior mediastinum and *n. phrenic.* from *vagus*.

2. Lateral parts. The lungs invested by the pleura *pulmonalis*.

696.

Abdomen, Venter.

1. *Reg. epigastrica*, extends from the termination of the *sternum* and the *eighth rib* as far as the inferior border of the *twelfth*, and to about the breadth of two fingers above the navel. A central and two lateral portions are described.

a. *Epigastrium, scrobiculus cordis*, gastric fossa, that is, the triangular, central part between *sternum* and the cartilages of the six last ribs. Behind the delicate, sensitive skin, the *fasc. superfic.*

with the cutaneous branches of sixth to eighth *nerv. intercostal.*; *proc. ensiform.*, *linea alba*, *m. rectus* in its sheath; *vasa mammaria*; laterally, *m. transversus* and *pars costal. diaphragma*. The following parts are met with:

1. The *left lobe* of the liver; 2. the *cardia*; 3. *pars pylorica* of stomach; 4. the *small omentum* and a part of the large; 5. the *second* and *third* portions of *duodenum*; 6. *Pancreas* surrounded by lymphatic glands, with *truncus cæliacus*; 7. the large vessels, *crura diaphragmat.*; first and second lumbar vertebræ.

b. *Hypochondrium dextrum*, contains the costal portion of the diaphragm and *lig. suspensorium hepatis*, is filled up by the liver. The fundus of the gall bladder corresponds to the cartilage of the ninth rib. We find therein: 1. *Flexura coli dextra*. 2. The first portion of *duodenum* and *cap. pancreat.* 3. Before the *foram. Winslow.*: *art. hepatica* in front [to the left]; *ductus hepatic.*, *cystic.* and commencement of *choledochus* in the centre [to the right]; *ven. porta* [between the two], and termination of *n. vagus dexter* behind. The right lobe of the liver rests against the right kidney and supra-renal capsules above and behind.

c. *Hypochondrium sinistrum*, contains the *fundus ventriculi*; above and before a small process of the left lobe of the liver; behind and to the left the spleen with *lig. gastro-splenicum*, between the anterior lamina of which the *vasa brevia*, between the posterior the *vasa lienalia* and the *cauda pancreatis*. Behind the stomach and below the spleen: the superior extremity of *colon. descend.*, the *left kidney*, and *caps. supra renales*.

Both *regg. hypochondr.* present, 1. A thick skin. 2. Fibro-cellular containing adipose tissue, *cutaneous veins* and branches of the inferior *nn. intercostales*. 3. A thin *aponeurosis* and *fascia superficial.* 4. *Mm. obliq. extern.* and *latissim. dorsi*. 5. *Costæ spuricæ* with *mm. intercostales*. 6. *Diaphragm*; on the inferior surface of which (abdominal cavity) the *peritoneum*; on the superior surface (thoracic cavity) *pleura costalis* and *phrenica*.

697. 2. *Regio mesogastrica*. This is the part below the last ribs and above the hip bones; distinguished in the centre as *regio umbilicalis*, at the sides *regg. lumbales*, loins. The abdominal wall is here thick; the peritoneum is firmly attached in the proximity of the navel to the *linea alba*, in which openings for vessels are found, especially above the navel. The abdominal wall in the region of the loins consists of, 1. Skin. 2. Areolar tissue (*fasc. superfic.*) in a thick layer between *m. obliq. extern.* and *longissim. dorsi*; passing, below the twelfth rib, into the areolar tissue of the

thorax. 3. *M. obliq. externus*; behind a small piece of *latissim. dorsi*. 4. *Fasc. lumbo-dorsalis*. 5. *M. obliq. internus*, covered before by *m. obliq. extern.* 6. Areolar tissue, with branches of *vasa circumflexa ilei* and *n. ileo-hypogastric.* 7. *M. transversus*. In the centre of the space between *navel* and *spina ilei ant. superior*, one is equally far removed from *artt. epigastrica, circumflexa ilei*, and *lumbales*.

In the abdomen are situated: 1. The *great omentum*. 2. *Colon transversum* (separated from the *reg. epigastrica* by *mesocolon transvers.*); the *small intestines*. 3. *Mesenterium*. At the sides, behind some of the convolutions of the small intestines: 1. *Colon ascend.* and *descendens*. 2. Kidneys and ureters in a considerable quantity of adipose tissue.

698. 3. Lumbar regions, *regio lumbalis*, lie right and left of the fine lumbar vertebræ, present in the centre a groove (with *proc. spinosi*) formed by the projecting *mm. ileo-lumbalis* and *longiss. dorsi*; are bounded below by *crista iliaca* and *spina posterior*. Parts: 1. Skin. 2. Condensed areolar tissue. 3. *Fasc. lumbo-dorsal.* (posterior layer). 4. *M. ileo-lumbar.* and *longissim. dorsi*. 5. *Fasc. lumbo-dorsal.* (anterior layer). 6. *M. quadratus lumb.*, which forms the most posterior portion of the abdominal walls. On the convex anterior surfaces of the lumbar vertebræ: 1. *Crura diaphragmatis*; right, *ven. cava*; left, *aorta*; externally, *nerv. sympathicus*; above, the commencement of *duct. thoracicus* and of *ven. azygos*. 2. *Lymphatic glands* and areolar tissue, which are connected with those of the *mesenterium*. Laterally: *m. psoas*; *plexus lumbalis*; and 2 to 3" below the last rib, the kidneys, in adipose tissue. To reach the *abdominal aorta* it is not necessary to open the peritoneum; between *m. psoas, quadratus lumborum*, and *peritoneum* we find areolar with abundance of adipose tissue.

699. 4. Inferior abdominal region, *regio hypogastrica*, extends from a transverse line, between the two *spinæ ilei*, as far downwards as the bones of the pubes.

Parts: 1. Skin (with pubic hairs). 2. Areolar tissue (*fasc. superf.*) over the pubes, thick and rich in adipose tissue, with *art. epigastric. superf.* 3. *M. pyramidalis, rectus* in its sheath; *lig. triangulare*. 4. *Mm. obliq. and transv.* 5. *Fasc. transv.*, belonging to the inferior fourth of *m. rectus*, immediately adjacent to which is the peritoneum. 6. *Art. and ven. epigastrica*; *Urachus*; *artt. umbilicales* and the superior third of the urinary bladder. 7.

Peritoneum. In the abdominal cavity : the small intestines, covered by the great omentum.

Lateral parts, inguinal regions, *regg. inguinales* (see next page).

Iliac fossa, *fossa iliaca interna*, between the vertebral column, the *crista ilii* and the crural arch are covered by *m. iliacus* and *psaos*. Between them *m. cruralis* passes ; transversely behind the *psaos*, *art. ileo-lumbalis* ; before it, *n. genito-cruralis* ; external to it, *n. inguino-cutaneus* ; close to the *crista iliaca*, the *art. circumflexa ilei*.

Vasa iliaca commun. and *hypogastrica* are covered by laminated areolar tissue (*fasc. propria*), and by :

1. *Fasc. iliaca*. Upon this lie : *art. iliaca*, in the direction of a line between the navel and the centre of the crural arch, on the anterior and outer side of the vein. 2. Peritoneum. 3. *Cæcum* on the right, *sigmoid flexure of colon* on the left, &c., as far as the external skin. The *fascia iliaca* envelopes the *psaos* above by its attachment to the vertebral column, and proceeds below the crural arch towards the *trochanter minor*, uniting with the *fascia lata*, (and thus forms the passage which the pus takes in *psaos* abscess.)

699. bis. *Regio inguinalis*, Inguinal region,

includes the parts which lie the breadth of two fingers above, and the breadth of three fingers below; the bend of the thigh, *plica inguinalis*.

In the upper part, close above *lig. Fallopiæ*, lie behind the skin :

1. Layers of *fascia superf.*, cutaneous veins between them.

2. *V. superf. abdom.*, $\frac{1}{2}$ to $\frac{3}{4}$ " distant from *annul. abdom.*; external to it, *art. epigastrica superficialis*.

3. *Lig. Fallopiæ* and the inferior portion of the tendon of *m. obliq. extern.* ; with *annul. abdom.* ($1\frac{1}{2}$ " removed from the *symphys. pubis*), and *canalis inguinalis*, which contains the spermatic cord or *lig. uteri rotund.*, *art. sperm. extern.*, *ram. intern. of nerv. spermat. extern.* and *nerv. ileo-inguinalis*.

4. Behind the inguinal canal : fasciculi of *m. obliq. intern.* and *transversus*.

5. *Fascia transversalis* forms, two inches distant from the *spina iliaca anter. super.*, the *annulus inguinalis (intern.)*.

6. *Fascia propria* (areolar tissue between *fasc. transversal.* and peritoneum), with *vasa epigastrica (interna)*, one fourth to half an inch distant from the internal boundary of *annul. inguin. (intern.)*.

7. Peritoneum with its folds, and *fovea inguinal. externa* and *interna*.

At the inferior part, below *lig. Fallopiæ*, lie behind the skin :

1. Layers of *fasc. superf.* with cutaneous veins, *ram. extern. nerv. spermat. externi*, *ven. saphena magna* (and *superfic. abdomin.*), which last opens one inch below *lig. Fallop.* into the *vena cruralis*, surrounded by superficial inguinal glands, outside *n. cutan. femor. anter. externus*.

2. Superficial layer of *fascia lata*, which forms *proc. falciform.* and *fovea ovalis*.

3. *Vena cruralis*, behind *fovea ovalis*; externally *art. cruralis* behind the outer part of *proc. falciform.*; on the outer side of the artery, *nerv. cruralis* in its sheath.

4. Upwards towards *lig. Fallopiae*: the crural canal and crural ring in the centre between *spina ilei anter. super.* and *symphysis pubis*, internal to and below the internal abdominal ring.

5. *Vasa cruralia*, surrounded by the deep inguinal glands, enclosed by the *vagina vasorum*, separated from *nerv. cruralis* by the deep layer of *fasc. lata*; internally, close to the vessels, the thin prolongation of *fascia transversalis* (*septum crurale*, Cloquet), and *lig. Gimbernati*; externally *m. psoas iliacus* with *nerv. cruralis* in its sheath.

6. *Eminentia ileo-pectinæa*, and *ram. horizontal. oss. pubis* above; *m. pectinæus* below; behind, the deep layer of *fasc. lata*, covers the *vasa obturatoria*, at their exit from the pelvis.

The triangular space between *lig. Fallopiae*, *ram. horizontal. pubis* and *os ilium* filled up internally by *lig. Gimbernati*, in the centre by the *vasa cruralia* and *nerv. cruralis*, externally, by the inferior part of *m. psoas iliacus* (between *spina ilei anter. infer.* and *eminent. ileo-pectin.*)

[Dissection. Above Poupart's ligament. 1. Make an incision through the skin only, transverse to the axis of the body, from the anterior superior spinous process of the *ilium* to the mesian line; from the termination of this, continue:

2. A vertical incision to the symphysis pubis. Reflect the skin towards the thigh, as far as Poupart's ligament. Examine the layers of superficial fascia. Reflect them, making incisions, as before, in the same direction. Clear away, after observing it, the external spermatic fascia, and make the boundaries of the external abdominal ring distinct. Through this, in the *male*, the *spermatic cord*, in the *female*, the *round ligament*, will be seen to pass; the incision may be extended downwards, following the course of these organs. An incision should now be made through the tendon of the external abdominal oblique muscle *only*, in a direction corresponding with No. 1, above, and the tendon reflected towards the thigh, the fibres connecting it with the subjacent tendons, and the tendon of the muscle of the opposite side

(the decussating fibres), being carefully divided. Examine next the free muscular edge of the *internal oblique* and *transversalis muscles*, and their conjoined tendons, as well as the fibres of the *cremaster muscle* in the *male*. From the junction of the outer with the middle third of Poupart's ligament carry an incision vertically upwards, parallel with the *linea alba*, dividing and reflecting inwards in succession, and outwards, the muscular fibres of *internal oblique* and *transversalis* muscles. The muscular fibres must be detached from the outer *third* of Poupart's ligament. From the commencement of the vertical incision the fibres may be separated in the direction of their fasciculi, namely, towards *linea semilunaris*. The *fascia transversalis* will now be exposed, the spermatic cord (or round ligament) resting upon its *pubic* portion, and lost in the *internal* abdominal ring, the external or *iliac* portion attached to Poupart's ligament. The *fascia spermatica interna* is to be examined, and then removed, to display more clearly the margins of the ring. Next push upwards and backwards the peritonæum, and observe the course of the *spermatic vessels*, the *vas deferens*, and the relations of the *external iliac* and *internal epigastric* arteries. The *fascia iliaca* and its attachments may likewise be studied.

Below Poupart's ligament. 1. Make an incision from the anterior and superior spinous process of the ilium to the centre of the thigh, the direction being inwards; in fact, parallel with the course of the fibres of the *Sartorius* muscle.

2. An incision from the spine of the pubes, downwards, to the termination of the last. Reflect the skin, only, upwards. Fat and fibro-cellular tissue forming more or less a superficial fascia, which encloses small arteries and veins, lymphatics, and their glands above, and the saphena vein below, may be reflected upwards. The fascia lata will be exposed, and immediately below the point at which the *saphena vein* is lost to view, by entering the sheath of the femoral vessels, it divides into an *internal pubic* and an *external iliac* portion. The handle of the scalpel may be passed under the *falciform process* of the latter, and upon raising it, the sheath of the femoral vessels is seen. The lymphatic vessels may be seen passing under Poupart's, and close to the outer border of Gimbernat's ligament, on the inside of the femoral vein, to the outer side of which is the femoral artery, each enclosed in separate fascial canals, the most internal being called the *crural ring*. To demonstrate this, make a small longitudinal incision through the anterior surface of the sheath, parallel to and over the centre of each vessel; then, with the handle of the scalpel passed along the sides of vessels, raise them from their fibrous canals. A considerable quantity of adipose tissue will be found surrounding the lymphatics below and at their entrance into the crural ring. Dividing carefully across, or detaching the posterior surface of Poupart's ligament from the anterior of the sheath of the femoral vessels (*septum crurale*), the connexion between this sheath and the *pubic* portion of *fascia transversalis* will be displayed. TRANS.]

Pelvis.

700. I. Pubic region, *regio pubis* (see parts of generation).

Cavity of the small pelvis. Behind the *symphysis pubis* :

1. Urinary bladder. 2. *Vas deferens* and *ureter* upon both sides (they cross each other). 3. *Fossa recto-vesicalis* in the male, *vesico-uterina* in the female. 4. In the female: *Uterus*, *vagina*, and broad ligaments (they divide the pelvis into an anterior and a posterior half); behind that *fossa recto-uterina*. 5. Behind and to the left, *rectum*, fixed above by *meso-rectum*, below by loose areolar tissue.

701. II. Perinæal region, *R. perinæi*,

closes the pelvic outlet, is bounded behind by the coccyx, on the side by *ligg. sacro-ischiatica*, *tuber* and *ram. ascendens ischii*, in part, by *ligg. pubicum inferius*; below, by the external skin, above, by the peritoneum. It is oval, passes forwards towards the root of the penis (or the *commisura poster. labior. pudend.*), and is divided by a transverse line extending between the two tuberosities of the ischia, into the anterior, proper perinæal, and into the anal region.

1. *Reg. analis*, region of the anus.

a. At the sides of the anus: 1. The skin. 2. Much areola, containing adipose tissue with *vasa* and *nn. hæmorrhoidal. inferr.* 3. *Fasc. perinæi*. 4. *M. levator* and *sphincter ani*. 5. *Fascia pelvis*. 6. *Peritoneum*.

b. Behind the anus: skin, condensed areolar tissue, containing adipose, posterior extremity of *sphincter ani*, *fascia perin.*, *mm. levatores* in the *raphe*, *fascia perin. superior*, fat and areolar tissue, *coccyx*, and *sacrum*.

2. *Reg. perinæalis* s. *uro-genitalis*, the anterior triangular part of the perineum, between the pubic arch and a transverse line between the two *tubera ischii*.

a. In the male: 1. Skin, wrinkled, thin, hairy. 2. Loose laminated areolar tissue with adipose, which continues on to the scrotum. 3. *Fascia superficialis* with the *vasa* and *nn. perinæi superfic.* (in the direction of *tuber ischii* of the one to the *spina pubis* of the other side.) *M. bulbo-cavernos.* in the centre, *transvers.* and *ischio-cavernosi* on the sides. 5. *Bulbus urethræ* in the centre, *corp. cavernos.* on the sides; in the triangular space between the two, two or three lines from the *ram. ascend. ischii*, crosses *art. transvers. perinæi*; 4. and 5. lie in a sheath formed of *fasc. superfic.* and *profunda* s. *media*. 6. *Lig. perinæale*; it is perforated by *bulb. urethræ* and *vasa*, *nn. dorsal. penis* (between *corp. cavernos.* and

ram. descend. pubis). 7. Between fascia perinæi and pelvis lie from before to behind :

a. *Pars membranacea urethræ* with Cowper's glands and invested behind by *mm. bulbo-cavernosus*.

b. *Prostata, pars prostat. urethræ* and *collum vesicæ*, attached above by *lig. pubo-prostaticum* (six to eight lines behind the *symphysis pubis*, two or three above the *anus*).

c. *Vesiculæ seminales*, and *vasa deferentia* between them, and crossing with the inferior extremity of the ureters. In the triangular space between them the *fundus vesicæ* rests upon the *rectum* ; between the last the neck of the bladder, prostatic and membranous portion of the urethræ, a triangular space also exists (which is taken advantage of in Lithotomy).

8. Anterior portion of *fasc. pelvis* (forms a sheath for the *prostata* and *plex. venosus prostaticus*). 9. Laminated areolar tissue. 10. Peritoneum.

b. In the female the proper perineum, that is, the region between the *labia. majora* and *orific. ani.* is shorter (fifteen lines long), but broader than in the male. *Fascia perinæi*, very strong ; the muscles are the same, only instead of *bulbo-cavernosus* the *constrictor vaginæ*.

The urethra (one to an inch and a half long, before, four to six lines, behind, three lines broad), passes backwards beneath the pubic arch on the anterior surface of the *vagina* curved rather upwards. Its orifice lies a quarter of an inch below the *clitoris*.

The *vagina* (four inches long, one inch broad) curved, ascends, backwards, between *urethra*, *bladder*, and *rectum* ; between their openings and that of the last a triangular space exists (the base of which lies below, since the *vagina* and *rectum* lie close upon one another, fifteen lines above the *orific. ani.*), in which adipose as well as areolar tissue, fibres of *mm. transvers.*, *sphincter*, *levator ani*, *constrictor vaginæ*, and the *vasa transvers. perinæi* are found. To their sides *fascia pelvis* is firmly attached.

The triangular space of the *vestibule* between the *clitoris* and the *orificium urethræ* is taken advantage of in Lithotomy ; in it we find : 1. The mucous membrane. 2. Very vascular areolar tissue in the centre, the roots of the *clitoris* covered by the *mm. ischio-cavern.* and the anterior extremity of *sphincter vaginæ* on the sides. 3. *Fascia perinæi* (with the *art. transvers. perinæi*) perforated by the *urethra*. 4. *Vv. dorsales clitorid.*, *collum vesicæ* and *ligg. pubo-vesicalia*. 5. The inferior portion of the anterior wall of the bladder.

The urinary bladder lies, in the female, higher over the perinæum, than in the male.

The *orificium ani* is broader, and is placed more posteriorly (behind a transverse line between the *tuber ischii*) than in the male.

[*Dissection.* 1. Of the *male* perinæum.

The subject should be tied up, as in the operation for lithotomy. The bony boundaries of the perinæal region must then be carefully recognised.

Incisions through the skin: 1. A vertical incision is to be made in the *raphé* from the arch of the pubes, which may be felt, or from the junction of the skin of the perinæum with that of the scrotum, to the anterior verge of the anus. 2. Transverse incisions, one on either side from the termination of the last to the outer sides of the *tubera ischii*. The two triangular flaps thus formed are to be reflected outwards over the thighs, and there fastened. 3. From the anterior verge of the anus carry two incisions, one on either side, around the opening, backwards, until they meet at the posterior verge in the middle line behind; from this point continue directly downwards to the coccyx. These two likewise triangular flaps are to be reflected over the thighs, and there secured. The sphincter ani is now to be dissected, and after examining the posterior portion of the superficial fascia, the *ischio-rectal fossæ* of either side may be cleaned out.

Continuing the dissection of the perinæum, make an incision in the middle line as before indicated, from the arch of the pubes, in front, to the anterior extremity of anus, behind, having previously reflected the superficial anterior fibres of the sphincter ani, or even dividing them also in the centre. Now, carefully dissecting the superficial fascia away from its posterior or deeper connexions, examine its relations with the deep perinæal fascia behind. Having done this, divide the junctions between them, and reflect the layers of the superficial fascia on either side, observing their attachments to the *anterior borders* of the *rami* of the *ischia* and *pubes*.

Care must be taken of the perinæal vessels and nerves which traverse this fascia. The muscles of the perinæum may now be dissected.

The *accelerator urinæ* should be detached from the deep fascia behind, for it does not arise from it, but is merely applied to its anterior surface. With a little care and dexterity, the handle of the scalpel may be gradually passed between the muscle and the spongy body which it surrounds. The tubular character of the muscle is then clearly demonstrated. The posterior portion of the corp. spongiosum and urethra may even be divided transversely, and then withdrawn from the muscular tube.

2. Of the *female* perinæum.

The vertical incision should be carried to the anterior commissure of the vagina, and then round the borders of its mouth, meeting at the posterior commissure, terminating in front of the anns. With this variation excepted, as in the male. TRANS.]

702. Axillary cavity, *fovea axillaris*, Axilla,

is triangular ; its base directed towards the chest, its apex towards the inner side of the upper arm, its anterior wall is formed by *m. pectoralis major*, *minor*, and the anterior portion of the *deltoideus* ; its posterior wall by *m. latissimus dorsi*, *teres major*, and *subscapularis* ; the inner wall by *m. serratus magnus* and the chest ; the external wall by *m. biceps*, *coraco-brachial*., upper arm (the uppermost part). The blunt apex forms a triangular opening, which is in connexion with the *reg. supraclavicularis* ; formed in front by the *clavicula*, behind by the superior border of *reg. scapularis*, internally and below by the first rib.

703. *Fossa infraclavicularis*,

is the name given to a triangular excavation on the anterior wall of the axilla, through which we pass to the apex of that fossa. It is bounded externally by the *head* of the humerus ; internally, by *proc. coracoid.* ; above, by *clavicula* and acromion ; and arises from the fissure between *m. deltoid.* and *pectoralis major*. Before it pass *vena cephalica* and *art. acromialis*. Behind that *vasa* and *nn. thoracici externi* ; *m. pectoralis minor* and *fasc. coraco-clavicularis*, *m. subclavius*. Beneath the hairy and thin skin at the base of the axilla, which is largely supplied with sebaceous follicles, a loose adipose areolar tissue is found, some superficial lymphatic glands, *fasc. brachialis* (between *m. pectoral. maj.* and *latissim. dorsi*), branches of *vasa axillar.* and the *v. axillaris*, deep lymphatic glands, *vena* and *art. axillaris*, the trunks of nerves, laminated areolar tissue, and the shoulder joint.

Art. axillaris passes : a. between the first rib and the superior border of *m. pectoral. minor*, on the outer side of *v. axillaris*, on the inner of the inferior branch of *plex. nerv. brachialis* and *proc. coracoid.*, supported upon *m. intercostal. I.*, the second rib, and *m. serrat. antic. major.* ; b. behind *pectoralis minor*, covered by the two roots of the *n. medianus* before, closer to the humerus ; c. from the inferior external border of *m. pectoral. minor*, as far as to the inferior limit of the *axilla*, behind *v. axillar.*, internal to and behind *nerv. medianus*, *m. coraco-brachial.*, *cap. breve bicip.*, and *os humeri* ; before *nerv. ulnaris*, before and internal to *n. radialis* and *axillaris*. Behind it, *plex. lymphaticus*, tendons of *subscapularis*, *m. latissim. dorsi*. The direction of *art. ven. axillaris*, and the *plex. brachialis*, is oblique from above and within, to below and without (from the anterior internal angle of the axilla to its external).

On the costal parietes pass ; *art. mammaria externa* (in front), *n. thoracic. poster.* (behind) and *nn. cutanei brachii*.

On the posterior wall of the axilla : a branch of *art. scapular. commun.*, a *nerv. infrascapular.*, and lymphatics.

The largest number of lymphatic glands lie at the internal anterior angle above the *mm. pectorales*, and close to the axillary border of the scapula.

The Extremities.

704. *Plica cubiti*, bend of the elbow,

is the angle in the anterior region of the elbow, which the articular ends of the upper and forearm form with one another. We there find under the skin and fascia, which above passes into the *f. brachii*, below into the *vagina cubiti*, the *fossa cubiti*, a triangular depression bounded externally by *m. supinator longus*, internally by *pronator teres*, at the base by the tendon of the *biceps*, and *m. brachialis internus* (above), the origin of *flexores commun. digit.* and *supinat. brevis* (below). Position of the parts in the *fossa cubiti* :—

1. *Ven. mediana*. 2. *Aponeurosis bicipitis*. 3. *Art. brachialis* between its veins. 4. *Nerv. medianus* on the inner. 5. Tendon of *biceps* on the outer side of the artery.

705. *Fossa poplitea*, bend of the knee,

a rhomboidal shaped space on the posterior (flexion) side of the knee, is formed below by the two heads of *m. gastrocnemius*, the inner of which is the longer, and partly covered by the tendon of *semimembranosus* ; the external superior side by the *biceps*, the internal by the belly of *semimembranosus*, then by the tendons of the last-named muscle, the *semitendinosus*, *gracilis*, and *sartorius*.

Position of the parts : 1. Skin thin, smooth, and very extensible. 2. Fibro-cellular tissue with adipose, in which cutaneous veins and the terminal branches of *nerv. cutaneus femor. poster. magn.* and *nerv. cutan. post. medius*. 3. Fascia lata ; forming, with a superficial layer, an arch over the fossa, covers with a deep layer the limits and the floor of it ; surrounding also, besides lymphatic glands, fibro-cellular and adipose tissue, the vessels and nerves.

a. *Art. poplitea*, passes pretty nearly in the centre of the fossa,

is entirely covered above by *ven. poplitæa*, fibro-cellular tissue, fascia, and skin, at the lowest part by *m. gastrocnem.*, and the obliquely passing *m. plantaris*.

b. *Ven. poplitæa*, firmly adherent to the posterior external side of the artery.

c. *Nerv. tibialis*, to the posterior external side of the vein, passing away obliquely behind it to the inner side.

DISTRIBUTION OF THE ARTERIES AND NERVES OF THE

706.

FINGERS.

TOES.

*Art. volares.**Artt. plantares.*

Art. radial. pollicis arises from *ram. dorsal.*, or *volar. art. radial.*
ulnaris - - - - - { *arcus volar. subli-*
radial., and *ulnaris indicis* - - - - - *mis* united with
- - - - - *dig. medii* - - - - - branches of *arcus*
- - - - - *annularis* - - - - - *volaris* *profun-*
- - - - - *auricularis* { *dus.*

Art. tibial. hallucis arises from *art. plantar. int.*
- *fibular.* { arise from *arcus*
- *tibial.* and *fibul. dig. II.* } *plantaris*, formed
- - - - - *III.* } by *art. plantar. ex-*
- - - - - *IV.* } tern. and *art. in-*
- - - - - *V.* } *terosæ* (between
- - - - - } the *tibial. art.*.)

Branches
of *art. ti-*
bialis
postica.

*Nervi volares.**Nervi plantares.*

Nerv. radial. poll.
- *ulnaris* - - - - -
- *radial. indicis* - - - - -
- *ulnaris* - - - - - } from *ram. superfic. nerv. mediani.*
- *radial. dig. medii* - - - - -
- *ulnaris* - - - - - }
- *radial annularis* - - - - -
- *ulnaris* - - - - - }
- *radial. auricularis* - - - - - } *ram. volar. nerv. ulnaris.*
- *ulnaris* - - - - - }

Nerv. tibial. hallucis from *ram. intern. nerv. plant. int.*
- *fibularis* - - - - -
- *tibial. dig. II.* - - - - -
- *fibularis* - - - - - } from *ram. extern. nerv.*
- *tibialis dig. III.* - - - - - } *plant. int.*
- *fibularis* - - - - - }
- *tibialis dig. IV.* - - - - - }
- *fibularis* - - - - - }
- *tibialis dig. V.* - - - - - } from *nerv. plant. extern.*
- *fibularis* - - - - - }

Branches
of *nerv.*
tibialis.

Arti. Dorsales.

Art. <i>radialis pollicis</i>	{	<i>ram. dorsal. art. radialis.</i>	{	from <i>rete carpeum dorsale</i> , formed by <i>ram. dorsales</i> of <i>art. ulnaris</i> , <i>interossea dorsalis et volaris</i> , and <i>art. radialis</i> .
— <i>ulnaris</i> —				
— <i>radialis indicis</i>				
— <i>ulnaris</i> —	{			
— <i>radialis dig. medi.</i>				
— <i>ulnaris</i> —				
— <i>radialis annul.</i>				
— <i>ulnaris</i> —				
— <i>radialis dig. min.</i>				
— <i>ulnaris</i> —				

<i>Art. tibialis hallucis</i>	{	from <i>art. inteross. dorsal. I.</i>	<div>Branches of <i>art. ti- bialis an- tica.</i></div>
- <i>fibularis</i> -			
- <i>tibialis dig. II.</i>	{	from <i>arcus tarsus dorsalis</i> , formed by <i>art. metatars.</i> , united with <i>art. tarsea ex- terna.</i>	
- <i>fibularis</i> -			
- <i>tibialis dig. III.</i>			
- <i>fibularis</i> -			
- <i>tibialis dig. IV.</i>			
- <i>fibularis</i> -			
- <i>tibialis dig. V.</i>			
- <i>fibularis</i> -			

Nervi dorsales.

<i>Nerv. radialis pollicis</i>	from <i>ram. superf. anter. nerv. radialis.</i>
— <i>ulnaris</i> —	{ from <i>ram. superf. post. nerv. radialis.</i>
— <i>radialis indicis</i>	
— <i>ulnaris</i> —	
— <i>radialis dig. medii</i>	
— <i>ulnaris</i> —	{ from <i>ram. dorsal. nerv. ulnaris.</i>
— <i>radialis annul.</i>	
— <i>ulnaris</i> —	
— <i>radialis dig. min.</i>	
— <i>ulnaris</i> —	

<i>Nerv. tibialis hallucis</i>	{ from nerv. dorsal. ped. intern.	{ from nerv. dorsal. ped. medius.	{ Branches of ram. superfic. nerv. pe- ronæi.		
— <i>fibularis</i> —					
— <i>tibialis dig. II.</i>					
— <i>fibularis</i> —					
— <i>tibialis dig. III.</i>	{ from nerv. dorsal. ped. medius.			{ Branches of ram. superfic. nerv. pe- ronæi.	
— <i>fibularis</i> —					
— <i>tibialis dig. IV.</i>					
— <i>fibularis</i> —					
— <i>tibialis dig. V.</i>	{ from nerv. dorsalis pedis externus, receiv- ing branches from nerv. tibialis.				{ Branches of ram. superfic. nerv. pe- ronæi.
— <i>fibularis</i> —					
— <i>tibialis dig. V.</i>					
— <i>fibularis</i> —					

d. *Nerv. peronæus*, on the inner side of *m. biceps*, covered only by fascia, on the posterior surface of *condyl. extern. femor.* to the outer side of *condyl. extern. tibiæ*, as far as behind *capitul. fibulæ*.

The two nerves (c and d) receive the art. and vein in the centre between them.

4. *M. popliteus*, 5. *Ligam. popliteum*, pass obliquely downwards from *condyl. extern. femoris* to *condyl. intern. tibiæ*. 6. *Fossa condylorum posterior* of the knee joint.

Situation of the Viscera, relative Position of the Organs in the Three Great Cavities.

708.

Cranial Cavity.

After removing the cranial bones we directly come to

1. *Dura mater*, from the internal surface of which the following processes pass between the recesses of the brain :—

1. *Proc. falciformis major*, s. *falx cerebri*. Its superior convex border extends from *foram. cæcum* and *crista galli* of *ethmoid* bone along the *crista frontal. interna*, beneath the central line of the cranial arch as far as *protuberant. occipital. interna*; containing the *sinus longitudinal. superior*. Its inferior concave border is extended freely between the two hemispheres of the cerebrum, close above the *corp. callosum* in the *scissura longitudinal. cerebri*; it contains the *sinus longit. inferior*.

2. *Tentorium cerebelli*; lies over the *fossa cranii inferior*, transversely between the lobes of the *cerebrum* and the superior surface of the *cerebellum*, below the *falx cerebri* and above the *falx cerebelli*. In the middle line passes *sinus quartus* [straight or horizontal sinus]. Its external convex border is attached to the *lineæ cruciatæ transversæ occipitis*, the *angulus super. oss. petrosi*, as far as the *proc. clinoid. poster.*; contains *sinus transvers.* and *petrosi superiores*. Its free, internal, concave border reaches as far as the *corp. quadrigemina*, *splenium corp. callosum* and *pons Varolii*.

3. *Process. falciformis minor* s. *falx cerebelli* lies in the *incisura cerebelli poster.*, between the *hemisphær. cerebelli*, behind *tuber valvul.* and *pyramis vermis*, beneath the centre of the *Tentorium*, and extends along the *crista occipital. interna* from the *protuberantia* as far as *foram. magnum*; containing, at the posterior attached border, *sinus occipitalis posterior*.

4. *Process. spurii duræ matris* are visible after the brain is removed from the skull.

a. Roof of the *sella turcica*, stretched between *proc. clinoid.*

anter. and *poster.*, covers the *fossa pro gland. pituitar.*, presenting in the middle a foramen for *infundibul.* and *sin. circular Ridleyi*.

b. Between the apex of the *petrous* and the *ala parva* of *sphenoid* bone, the superior external wall of *sin. cavernos.*, and farther outwards the *sin. ophthalmicus* is formed.

c. Tubular sheaths for vessels and nerves penetrate the foramina of the *basis cranii*.

5. Sinus; are found between the layers of the *dura mater*.

a. *Sinus transversi* in the *sulcus transvers.*, at the posterior border of *tentorium cerebelli*. Into it open

1. *Sinus longitud. super.*; passing along the convex border of *falx cerebri*; opens into the right *sin. transv.* on the *protuberantia occipit. interna*.

2. *Sinus quartus*; [straight] passes into the centre of *tentorium*, from before backwards; receiving where *tentorium* and *falx cerebri* unite,

Vena magna Galeni, which, arising by the confluence of *vv. cerebrales internæ*, pass into *plexus choroid.* 3.

Its posterior extremity enters the left *sinus. transversus* (*s. torcular. Herophili*).

3. *Sinus longitud. inferior*, on the concave border of *falx cerebri*, passes into *sinus quartus*.

4. *Sinus petrosus superior*, in the *sulcus petrosus* on the superior angle of *pars. petrosa*; unites *sinus cavernos.* with *transversus*.

5. *Sinus petrosus infer.*, between the apex of *pars petrosa* and the *clivus*; opens at the *foram. jugulare* into the *sinus transversus*.

b. *Sinus occipitalis posterior* passes on the *crista occipit. interna*, from the *torcular Herophili* downwards to the *sinus circular. foram. magni*, which lies upon the posterior boundary of *foram. magn.*, and is connected with the so-called *sin. occipit. ant. s. basilar.* upon the *clivus* and the *fossa pro medulla oblongata*.

c. *Sinus cavernosi* passes on both sides of *sella turcica* between the apex of *petrous* and *ala parva* of *sphenoid* bone. Into it discharge,

1. *Sinus circularis Ridleyi*; surrounding the *hypophysis cerebri*.

2. *Sinus spheno-parietales s. ophthalmici* (ant. extremity of *sin. cavernosi*); at the inferior extremity of *fiss. orbitalis superior*.

3. *Sinus petrosi anteriores*; between *pars squamosa* and *petrosa* of temporal bone (often wanting).

II. *Arachnoidea*, surrounded by the *Dura*, it surrounds the *pia*

mater ; it is extended like a bridge across all the depressions, and over all the *sulci* of the brain.

III. *Pia mater*, slightly attached to the free surface of the brain, and entering into all its *sulci*, depressions and cavities, it closes the fourth ventricle at the *fissur. transv. cerebelli*, [abnormally] and the third ventricle even at the *foram. Bichat.* in the *fiss. transv. cerebri*.

709. IV. *Cerebrum*, great brain. Its superior convex surface looks towards the cranial vault, and is divided into two hemispheres by the

Scissura longitudinalis, which penetrates as far as *corpus callosum*, in front, before the *genu corpor. callosi*, and between the anterior cerebral lobes to the base of the skull ; behind, posterior to *splenium corp. callosum*, and between the posterior cerebral lobes to the *cerebellum*, and receives the *falx cerebri*.

Anterior cerebral lobes. Their inferior surfaces lie upon the *fossa cranii anterior* ; their internal surfaces meet together ; behind they are separated from the middle lobes by the *fossa Sylvii*. On the inferior surface, towards their inner border, the *sulcus tractus olfactorii* is seen, at the posterior termination of which, close before *substantia perfor. media*, lie the *corp. mammillaria*.

Middle cerebral lobes are indistinctly bounded behind by *margo petrosus* of petrous bone, and they occupy the *fossæ cranii mediæ*.

Posterior cerebral lobes occupy the space in the *fossæ occipitales superiores*. Between them and the *cerebellum* the *fissura transv. cerebri* leads to *splen. corp. callos.*, *corp. quadrigem.*, *ventricul. 3.*, and *laterales*.

710. V. *Cerebellum*, lesser brain, fills up the *fossæ occipitales inferiores*, is divided by the horse-shoe-shaped *incisura poster.*, at the posterior border and *falx cerebelli*, into two hemispheres, by a deep transverse groove, *sulcus horizontalis Reilii*, into a superior and inferior half, united in the middle line by the *vermis* [*proc. vermiformis*]. The *vallecula* on the inferior surface of the *vermis* receives anteriorly the *pons Varolii*, behind the *medulla oblongata*. Between the last and the *cerebellum* the *fissura transversa cerebelli* leads into the *fourth ventricle*. The superior surface of the *cerebellum* is separated from the posterior lobes of the *cerebrum* by the *tentorium*.

711. VI. *Basis encephali*. We find in the middle line from behind to before,

1. *Medulla oblongata*, upon the *pars basilar. occipitis*, between the *hemispheria cerebelli*, behind *pons Varolii*. In its middle line:

a. *Fissura long. anterior*; on the side of this:

b. *Corp. pyramidalia*. Next to these the *olivary* bodies, and most posteriorly and externally the *corp. restiformia*.

2. *Pons Varolii*, upon the *clivus*, behind the *crura cerebri*, between the *crura cerebelli ad pontem*.

3. *Substantia perforata media*, between *crura cerebri*.

4. *Corp. mammillaria*, above *proc. clinoidei posteriores*, between *crura cerebri*.

5. *Tuber cinereum*, between the anterior extremities of *tractus optici*, elongating itself forwards and downwards in the *infundibulum* to the *hypophysis* in the *sella turcica*.

6. *Chiasma nerv. opticorum*, upon the *proc. clinoidei medii*, between the two *laminae cribrosæ*, which lie before the *crura cerebri* at the commencement of *fossæ Sylvii*, and the posterior extremity of *sulcus tractus olfactorius*. On the sides of the base are situated,

1. *Fossa Sylvii*, with the *insula* of Reil, and the *operculum*.

2. *Crura s. pedunculi cerebri*, behind the *tractus opticus*, before *pons Varolii*.

3. *Tractus opticus*, behind *lamina cribrosa*, before *crus cerebri*, winding round them.

4. *Gyrus hippocampi*, externally close to *crus cerebri*, forms in front the *uncus*.

712.

VII. Cerebral nerves.

1. *Olfactorius*, appears at the internal extremity of *fossa Sylvii* and *lamina cribrosa*, passes in the *sulcus tractus olfactorius* on the inferior surface of the anterior cerebral lobes, enlarges (*bulbus cinereus*) upon the cribriform plate of the *ethmoid* bone, and quits the cranial cavity with a double series of filaments.

2. *Opticus*, appears at the anterior border of *chiasma*, passes through *foram. opticum*, where it lies above and internal to *art. ophthalm.*, into the orbit, where it is situated on the outside and below it.

3. *Oculo-motorius*, appears on the inside of the *pedunc. cerebri*, passes through a fissure of the *dura mater*, approaching *proc. clinoid. post.*, into the *sinus cavernosus*, along the superior wall, outside the *carotis interna*; enters the orbit through *fissura orbital. superior*.

4. *Trochlearis*, appears at the anterior lateral border of *pons Varolii*, before the *crus cerebelli ad pontem*, perforates the *dura mater* behind *proc. clinoid. post.*, passes in a canal formed by it above the apex of the petrous bone, between the superior and outer wall of *sinus cavernosus*, to the *fiss. orbital. super.*, and into the orbit.

5. *Trigeminus*, appears at the anterior lateral border of *pons Varolii*, before the *crura cerebelli ad pontem*, external to *trochlearis*, penetrates the anterior border of *tentorium* close above the apex of the petrous bone, and there forms the *ganglion Gasseri*, from the inferior border of which its first, second, and a portion of its third division pass off.

Ramus I. passes through *fissura orb. superior*.

— II. through *foram. rotundum*.

— III. through *foram. ovale* out of the skull.

6. *Abducens*, appears between the posterior border of *pons Varolii* and the *corp. pyramid.*, enters through the fissure of the *dura mater*, on the *clivus*, into the *sinus cavernos.*, and passes, when in this, on the outer side of the *carotis* to the *fiss. orbital. superior*.

7. *Facialis*, appears at the posterior lateral border of *pons Varolii*, between *crus cerebelli ad pont.* and *corp. restiforme*, passes in a *sulcus* of the *acusticus*; and enters, by the *meatus auditor. intern.*, into the *canal Fallopiæ*.

8. *Acusticus*, appears externally close to the last, passes to *meatus auditor. intern.* between *corp. olivare*, *floccul.*, and *crus cerebelli ad pontem*.

9 and 10. *Glosso-pharyngeus* and *vagus*, appear below the posterior border of *pons Varolii*, between *corp. olivare* and *restiforme*, they pass out through *foram. jugulare* [post. lacerated foramen].

11. *Accessorius Willisii*, passes through *for. magnum* into the *cranium*, and leaves it through *foram. jugulare* [post. lacerated foramen].

12. *Hypoglossus*, appears between *corp. olivare* and *pyramid.*, passes out through *foram. condyloid. antierius*.

713. VIII. Arteries [see § 552, and 554.]

1. *Carotis cerebralis*, enters the *sinus cavernosus* at the apex of the petrous bone, surrounded by *plexus carotic. intern.*, lies upon the outer inferior side of the *sinus*. penetrates it behind *foram. opticum*, gives off *art. ophthalmica*, and divides into the three following arteries :—

a. *Art. corpor. callos.* [ant. cerebral], lies at its commencement before the *chiasma* above *n. opticus*, then in the *scissura longitudinal*.

- b. *Art. fossæ Sylvii* [middle cerebral], commences below the *lamina cribrosa*, then in *fossa Sylvii*.
- c. *Art. choroidea*, external to *crus cerebri*, below *tractus opticus*, enters the *cornu descend.* of the lateral ventricle.
2. *Circulus arteriosus Willisii*, above and close to the *sella turcica*, surrounds the *chiasma*, *tuber cinereum* and *corp. mammillaria*.
3. *Art. vertebralis*, enters into the cranial cavity at the posterior lateral part of *foram. magn.*, lies at first on the side of, then obliquely before the *medulla oblongata*. The two vessels unite and pass as *basilaris* upon the *clivus*.
- a. *Art. basilaris* gives off: *art. auditoriæ internæ*, *cerebelli inferiores* and *superiores*, and divides at the *proc. clinoid. post.* into the two *artt. profunda cerebri* [posterior cerebral], which pass around the *crura cerebri* to the posterior cerebral lobes.

714. Thorax [compare § 695.]

After removing the sternum we arrive at the pleura with the lungs laterally, in the centre the *cavum mediastini antici*, the *pericardium* with the heart, and the *cavum mediastin. postic.* with *trachea*, *œsophagus*, vascular and nervous trunks.

715. I. Pleuræ. Each pleural sac is united to the lateral thoracic parietes as *pleura costalis*. The right lies obliquely from above to below, and from right to left, so that above it reaches as far as the right border of *manubrium sterni*, below to the centre of *corp. sterni*. The left attaches itself to the left border of the *manubrium*, below to the external extremity of the sixth and seventh rib cartilage.

From these points the *pleura costalis* turns backwards on either side to the lateral regions of the pericardium and the roots of the lungs as *mediastinum anticum*.

Each *pleura costalis* goes backwards to the front of the heads of the ribs and to the sides of the vertebral bodies, and hence turns forwards to the lateral surfaces of the pericardium and to the roots of the lungs as *mediastin. posticum*.

Below, the pleura is united with the convex surfaces of the diaphragm, *pleura phrenica*; posteriorly and at the sides it extends to the last ribs.

Ligamentum pulmonis, extends from the *pleura phrenica* to the posterior border of the inferior lobe of the lungs, and here passes over into the

Pleura pulmonalis, which invests the entire surface of the lungs,

forming between the lobes *ligg. interlobularia*, and at the roots of the lungs covering the parts entering and passing out.

716. II. Lungs. Each of the two lungs rests with the concave basis upon the convex surface of the diaphragm. The rounded apex reaches about one inch above the first rib. Their convex external surface is turned towards the concavity of the ribs, and shows on the right lung two *incisuræ interlobulares* passing from behind forwards, on the left one *incis. interlobular.*, so that the former is divided into three, the latter into two lobes.

717. III. Pericardium, extends from the point of junction of the sixth and seventh rib cartilage with the sternum of the right side: a rhomboidal piece of its anterior surface looks freely into the *cav. mediast. anticum*. It envelopes

718. IV. The Heart, the posterior inferior surface of which rests upon the diaphragm, the basis of which lies to the right, above and behind as high as the sixth dorsal vertebra, the apex to the left, in front and below, behind the anterior extremity of the cartilage of the sixth and seventh left ribs. *Sulcus longitudinalis, transversus. Ventriculi, atria* and *auriculæ cordis* (see Heart, § 527.)

Besides the coronary veins, there open into the heart:

1. *Vena cava superior*, formed by the junction of the two *anonymæ* [*ven. brachio-cephalicæ*] behind the first and second right costal cartilages, passes before *art. pulmonal. dextra*, to the right and rather behind the commencement of the *Aorta*, into the *atrium dextrum*.

a. *V. anonyma dextra* [right brachio-cephalic] lies perpendicularly before the first (right) costal cartilage, before and internal to *nerv. phrenic. dexter* and *art. mamm. intern. dextra*.

b. *V. anonym. sinistra* [left brachio-ceph.] horizontal behind the *manubrium*, close above *arcus aortæ*, before *art. anonyma, carotis* and *subclavia sinistra*.

3. *V. cava inferior*, passes through *foramen quadrilaterum* of the diaphragm from the *ventral* into the *thoracic* cavity, and immediately into the *pericardium*, where it turns forwards and to the left, and before the eighth and ninth dorsal vertebra sinks into *atrium dextrum*.

3. *Venæ pulmonales*, pass forth with two trunks from the root of each lung, lie behind and below the other large blood-vessels of the heart and behind the *bronchi*, advancing towards those of the opposite side, and opening into the *atrium sinistrum*.

From the heart arise, besides the coronary arteries,

1. *Arteria pulmonalis*, which lie the most anterior of all the vascular trunks. Origin: *ventriculus dexter*, behind *auric. sinistra*, covering the origin of the *aorta*. Divides on an elevation with the third dorsal vertebra. The left trunk passes obliquely backwards over *vv. pulmonal. sinistra.*, before *aorta descend.* and *bronchus sinister* with two branches to the left lung. The right branch below *arcus aortæ*, before *bronchus dexter*, behind *aorta ascendens* with three branches to the right lung. From the angle of division the *lig. arteriosum (duct. art. Botalli)* passes to the concavity of *arcus aortæ*, internal to *nerv. vagus sinister*.

2. *Aorta*, arises from the left ventricle, ascends behind *art. pulmonalis* as *aorta ascendens* from left to right, lying there between *art. pulmon.* (to the left) and *v. cava sup.* (to the right), forms on an elevation with the second intercostal space the *arcus aortæ*, which passes from right to left and from before backwards into the *cav. mediast. post.*; and downwards as far as the fourth dorsal vertebra. Here it descends as *aorta descend.* close to the left side of the vertebral column, first close, then behind the *æso-phagus*, and passes through *hiat. aortic.* in the region of the twelfth dorsal vertebra into the abdomen.

From its convexity arise

a. *Art. anonyma* [*art. brachio-cephalic.*], lying the farthest to the right and in front, behind *manubrium sterni*, before *trachea*; divides into *carot. commun.* and *subclav. dextra.*

b. *Carotis comm. sinistra*, at the commencement before, then to the left of *trachea* and *æso-phagus*, behind *manubrium*, *ven. brach. ceph. sinistra*, and *m. sterno-hyoideus*.

c. *Subclavia sinistra*, the farthest to the left and behind, before the termination of *m. longus colli*.

1. *Mammaria interna*, arises from the ant. inf. surface of *subclavia*, turns, at the commencement, forwards, then downwards, passes inwards between two veins, before the pleura on the inner surface of (one to seven) costal cartilages as far as *proc. ensiform.*, where it bifurcates into its two terminal branches, *ram. musculo-phrenic.* and *epi-gastricus*.

719. V. *Vena azygos* and *hemiazygos (v. conjugatæ)* pass along on either side between *crus extern.* and *med. diaphrag.* into the *cavum mediast. post.*, passing close to the bodies of the dorsal vertebræ as high as the eighth, where they unite in the *ven. azygos*. This passes upwards to the right of the *aorta* and the *ductus*

thoracicus as high as the third and fourth dorsal vertebræ, curves around *bronch. dexter* and *art. pulmon.* forwards to the posterior wall of *ven. cava sup.*, in which it terminates.

720. VI. *Ductus thoracicus* passes through *hiat. aortic.*, lying between *aorta thoracic.* and *ven. azygos* before the bodies of the vertebræ; goes to the left, in the region of the fifth and sixth dorsal vertebræ behind the *œsophagus* and the termination of *arc. aortæ*, and opens in the angle between *ven. jugular. interna*, and *subclavia sinistra*.

721. VII. *Trachea*, behind the *manubr. sterni*, *ven. anonyma*, and *carotis sinistra*, it divides before the third dorsal vertebra, close behind *arcus aortæ*, into the two *bronchi*. *Bronch. dexter* [the largest] lies behind *v. cava super.*, passes away under the curve of *v. azygos*; *bronch. sinister* [the longest and most oblique] under the arch of the *aorta* to the lungs. Both lie behind the *art.* and above the *v. pulmonales*.

722. VIII. *Æsophagus* passes behind the trachea and rather to the left of it, into the *cav. mediastin. post.*; lying, at the commencement, more in the central line, and to the right of the *aorta*; lastly to the left and before *aorta* and *duct. thoracic.*, and enters, upon a plane with the ninth dorsal vertebra, the abdominal cavity through *for. œsophageum*.

723.

IX. Nerves.

1. *Nerv. vagus*, passes down and close to *carotis*, rather external to it, before *art. subclavia* and behind *ven. anonyma* obliquely into *cav. mediast. anticum*.

a. *N. recurrens dexter*, passes off from it, and around the *art. subclavia dext.* backwards to the *larynx*: *sinister* likewise around the *arcus aortæ*. Both ascend behind the carotis in the groove between *trachea* and *œsophagus*.

b. *Nn. pulmonales*.

The *vagus* then turns into the *cav. mediast. post.*, passes obliquely inwards behind the *bronchi* to the *œsophagus* (the left on its anterior, the right upon its posterior surface), and are lost through *for. œsophageum* of the abdominal cavity.

2. *Pars thoracica nerv. sympathici*, lies on the outside of *cav. mediast. post.* behind the *pleura costalis*, close to the vertebral bodies, before the *proc. transv.* and heads of the ribs. *Ganglia thoracici* (eleven to twelve) between, upon, or before the heads of the ribs.

a. *Splanchnicus major*, arises from six to ten *ganglia*

thorac., entering the abdominal cavity between *crus med.* and *intern. diaphragm.*

b. *Splanchnicus minor*, arises from nine to ten *ganglia*, perforates the *crus medium*. Both lie more anterior and internal than the trunk of *sympathicus*, before the *vasa intercostal.*; upon the left side, close to the *aorta*; upon the right, close to *ven. azygos*.

3. *Nervus phrenicus*, enters the *cav. mediastin. antic.*, on either side behind the outer portion of *artic. sterno-clavicularis* before *art. subcl.* and behind *v. subcl.*, on the outer side of *art. mammaria interna*, contiguous to the *pericardium*; the right passes more anteriorly before *v. cava super.*, the left curved around the apex of the heart to the diaphragm.

724.

Abdominal Cavity.

1. Within the peritoneum (*Infra peritonæum*).

1. *Liver*, situated in the *hypochondr. dextr.*, extending on the left as far as into *epigastrium*. The convex surface in the concavity of the diaphragm, directed upwards and forwards; the concave surface downwards and backwards.

Lobulus dexter covers the superior part of the right kidney (*impressio renalis*), the *flexura coli dextra* (*impressio colica*), farther to the left and before the *duoden.*, *pylorus*, *lig. hepatico-renale* and *duodenale*; *foram. Winslowii*.

Lobulus sinister lies upon the small *omentum* and the *cardia*; *lob. Spigelii* in the *curvatura minor*.

Posterior superior border is obtuse, and unites with the diaphragm.

Inferior anterior border is acute, and directed downwards.

On the inferior surface: *Fossa longitudinal. dextra* with the gall bladder—*fundus* below, *collum* directed towards *fossa transv.*; passes into *ductus cysticus*, which joins with *duct. hepaticus*, at an acute angle to form the *duct. choledoch.*, which opens into the posterior wall of *pars descend. duodeni*. At the posterior part lies *ven. cava inferior*.

Fossa longitudinal. sinistra with *lig. teres* (*ven. umbilical.*) before *duct. ven. Arantii* behind.

Fossa transversa presents: *v. portæ* and *art. hepat.* (vessels entering), *duct. hepat.* (passing out) surrounded by *capsul. Glissonii*, in the *lig. hepatico-duodenale*.

a. *Ven. portæ*, and to the right before it *art. hepatica*.

b. *Ductus hepaticus* before *v. portæ*, between *art. hepat.* (to the left) and *duct. cystic.* (to the right).

c. *Duct. choledochus* to the right, and rather before the *ven. portæ*, behind *duodenum*.

2. *Spleen*, situated in *hypochondr. sinistra*. Its thick superior extremity on the diaphragm, the thin inferior extremity above *flex. coli sinistra*. External surface towards the concavity of the last ribs and *pars cost.* of diaphragm. Internal concave surface bounded by *fund. ventriculi*, presents *hilus*.

3. *Pancreas*, behind the stomach, in the *reg. epigastr.*, before the large vascular trunks and the vertebral column. The head in the curve of the *duodenum*, the tail towards the spleen. The duct (*duct. Wirsungianus*) opens into *pars. descend. duodeni*.

4. *Stomach* in *reg. epigastrica* and *hypochondr. sinistra*. *Curvat. major* below, *minor* above; anterior wall behind the abdominal parietes; posterior before *pancreas*, *aorta*; *cardia* to the left and above, beneath *for. œsophageum*; behind *proc. xiphoideus*, in the *scrobiculo cordis*, and the extremity of the left lobe of liver; *pylorus* to the right, behind the *lobul. quadratus*. *Fundus* in the *reg. hypochondr. sinistra*, united to the *spleen*.

5. *Duodenum*. First portion, *pars horizont. super.* proceeding from the *pylorus* to the right, curves below the right lobe of the liver. Second portion, *pars. descend.*, before the right kidney to the region of the third lumbar vertebra. Second curve. Third portion, *p. horizontal. infer.* passes off to the left, then between the layers of the *mesenterium* into the jejunum.

6. *Jejunum* two-fifths, and ileum, three-fifths, traverse *regg. umbilical.*, *hypogast.*, *iliaca*, even into the depth of the pelvis (in the *excavat. recto-uterina* and *vesico-uter.*), passing in the *reg. iliac. dext.* into the large intestines.

7. *Cæcum*; with *proc. vermiform*, behind and external in *reg. iliac. dextra*, upon *m. iliacus dexter*.

8. *Colon, ascendens, transvers., descendens* with *sigmoid flexure* passes by the side of the last lumbar vertebra into the *rectum*.

9. *Peritonæum*, extends from the umbilicus upwards on the internal surface of the abdominal parietes to the diaphragm, forming in this way, as it surrounds the *lig. teres*, the *lig. suspensor. hepatis*.

From the concavity of the diaphragm it descends to the obtuse border of the liver as *lig. coronar. hepatis*, which at the sides passes over into the anterior layer of *ligg. triangularia*; covering the convexity of the liver it turns over the acute border to the inferior surface which it also covers as far as *lobulus Spigelii*, and completes laterally the *ligg. triangularia*. From the *fossa transv.* it goes to the *flexur. coli. dextr.* and right kidney (*lig. hepatico-colicum* and *-renale*) farther, to the *curvat. minor.* (*lig. hepat. gastric.*

s. *omentum minus*), and to the *duodenum* (as *lig. hepatico-duodenale*, which is continued to the right kidney as *lig. duodeno-renale*). On the left side it descends from the diaphragm to the anterior wall of the stomach and the spleen (*lig. phrenico-gastric.* and one layer of *lig. phrenico-lienale*), covers the anterior surface of the stomach, descends as one layer of the *great omentum* [turns upon itself], and ascends as the *fourth layer*, covering the *colon transvers.* as *mesocolon transvers.*, passes to the [inferior] border of *pancreas*, and attaches itself to the posterior abdominal parietes.

Foramen Winslowii is a space between *ven. cava* and *v. portarum* below the *tubercul. caudatum* of the liver. Through this the *saccus epiploicus* is tucked in. The anterior layer covers

lobulus Spigelii, forms the posterior layer of *lig. gastrico-hepatic.* (small omentum), covers the posterior surface of the stomach, descends as *second layer* of great omentum, and as *third layer* again ascends, covering [the transv. colon] the anterior surface of the *pancreas*, and turning back at the *lobul. Spigelii*.

Mesenterium. The root of the mesentery extends from the second lumbar vertebra to the *symphys.-sacro-iliac. dextr.* Between its two layers are found the convolutions of the small intestines. From the *symph. sacro-iliac.*, the peritoneum is continued upon the *cæcum, proc. vermiform., colon,* and *rectum*.

In the male it passes from the anterior surface of the *rectum* to the posterior of the urinary bladder, since it forms the *excavat. recto-vesicalis*, and on both sides the *plicæ semilunares Douglasii*, covers the lateral two-thirds of the posterior surface of the bladder, invests laterally the *lig. vesicæ lateralia*, and above the *lig. vesicæ suspensor.*, and then again ascends to the posterior surface of the anterior abdominal parietes.

In the female it forms the *excavatio-recto-uterin.*, *plic. Dougl.*, *lig. uteri lata*, *plicæ* and *excav. vesico-uterinæ*, passes upon the bladder, and so on.

Uterus lies in great part covered by peritoneum, above the *vagina*, between bladder and rectum, with the *fundus* in the entrance to the pelvis.

Tuba Fallopiae lies at the entrance to the pelvis, before and above the *ovary*, at the side of the *uterus*; its external extremity projects freely into the abdominal cavity.

Ovarium, between the layers of the broad ligament, over the round ligament, on the side of *fundus uteri*, and united with it by *lig. ovarii*.

Lig. uteri rotundum, below the *tuba* and the *ovarium*, on the lateral borders of the *uterus*.

725.

II. Outside the peritoneum,

in the abdominal and pelvic cavities are situated : the *capsula supra renales*, the *urinary organs*, *internal organs* of generation, the *rectum*, the superior portion of the *duodenum*, the great vessels and nerves.

1. *Caps. sup. renales*, situated in the *reg. hypochondriaca* on the posterior abdominal walls, upon the upper border of the kidney, below the diaphragm, the right behind the liver, the left behind *fundus ventriculi*.

2 Urinary organs, viz. kidneys, ureters, bladder.

a. *Kidneys*. They are placed in the *reg. lumbalis*, before *m. quadratus lumborum* and the eleventh and twelfth ribs, close to the first and third lumbar vertebræ, behind the peritoneum ; the right kidney behind *lobul. dexter, duodenum*, and *colon ascendens* ; the left behind the inferior extremity of the *spleen, cauda pancreat.* and *colon descendens*.

The internal border with the *hilus*, rests upon the *pars lumbal.* of diaphragm and *m. psoas*. In the *hilus* lie, from before backwards, *vena, arteria, pelvis renalis*.

b. *Ureter*, descends obliquely inwards from the pelvis of the kidney, with a sigmoidal curve ; before, *m. psoas* and *vasa iliaca* ; behind, the *vasa spermatica*, which descend obliquely outwards, and cross it ; it passes between rectum and psoas into the pelvic cavity, and to the posterior wall and lateral parts of the *fundus vesicæ*. Here it lies in the male, at first on the side, then between the *rectum* and *urinary bladder*, behind *vas deferens* ; in the female, close to *collum uteri*, below *lig. uteri rotund.*, then between bladder and *vagina*.

c. *Urinary bladder* ; it lies in *reg. pubis*, between the pubic bones and the rectum or uterus :

1. *Corpus vesicæ*, behind the *symphysis pubis*, before the *rectum* or *uterus*, touching laterally the side walls of the pelvis.

2. *Vertex*, projects upwards as far as the superior border of *symphysis pubis*, or, even above this, covered behind by peritoneum.

3. *Fundus*, situated anteriorly upon the *perinæum*, above the *vesiculæ seminal.* and *vasa deferent.*, behind upon the inferior portion of *rectum* (in the male) ; upon the anterior wall of *vagina* (in the female).

4. *Collum* (in the male surrounded by the prostate), lies over the anterior part of *perinæum* (the *vagina* in female), close behind the lower border of *symphysis*.

3. Internal organs of generation.

a. *Prostata* surrounds the *collum vesicæ* and the commencement of the urethra, situated close before the *vesicul. seminal.* and *vasa deferent.*, above the *perinæum* and the lower extremity of *rectum*; its anterior pointed extremity behind and below the *lig. arcuatum*.

b. *Vesiculæ seminales* are placed close together, behind and above the *prostata*, between *rectum* and *fundus vesicæ*, before and external to the *ureters* and *vasa deferentia*.

c. *Vas deferens*, passes on either side through the internal inguinal ring into the abdominal cavity, bends round *art. epigastrica* and over *vasa cruralia* backwards, inwards, and downwards, lying at first at the side, then on the fundus of the urinary bladder, before the ureter, and internal to the *vesic. seminal.* of its own side.

d. *Vagina*, between *rectum* and *bladder*, below the *fundus vesicæ* and *urethra*, in the axis of the lesser pelvis.

4. *Rectum*: it lies on the posterior wall of the pelvis from the *promontorium* down to the end of the coccyx; in women, behind *uterus* and *vagina*; in men, behind and below the *prostate*, *bladder*, *vesiculæ seminales*, and *vasa deferentia*. Its most superior portion is covered in front, and laterally by the peritoneum.

5. Vessels:

a. *Aorta abdominalis* descends through *hiatus aorticus* into the abdomen, lies close to the anterior surface of the lumbar vertebræ (as far as the cartilage between the fourth and fifth), to the left of *ven. cava infer.*, behind the *cardia*, *caput pancreat.*, third portion of *duodenum*, *radix mesenterii*. Its branches:

1. *Phrenicæ inferr.* and *cæliaca*, arise close under *hiatus aorticus*.

2. *Lumbares I.*, *mesenterica super.*, arise before the *twelfth dorsal vertebra*.

3. *Supra renales*, *renales*, *spermaticæ intern.* *Lumbares II.*, before the *second lumbar*.

4. *Lumbares III.*, arise before the *third lumbar*.

5. *Mesenterica inferior*, between *third and fourth lumbar*.

6. *Lumbares IV.*, before the *fourth lumbar*.

7. *Sacra media* and *iliacæ*, between *fourth and fifth lumbar*.

b. *Artt. iliacæ communes* descend obliquely from the place of division of the *aorta* outwards and backwards behind the *ureters*, on the inner side of *m. psoas*, as far as *symphys. sacro-iliaca*. The left lies immediately before the *vena iliaca sinistra* on the outside, the right goes first over *v. iliaca sinist.*, and then passes to the inner side of *v. iliaca dextra*. Their branches:

1. *Hypogastrica* [*iliac intern.*], lies close before *symphys. sacro-iliaca*, at the side of the posterior wall of the small pelvis.
2. *Iliaca externa* lies in the great pelvis, between *vena iliaca* (internally) and *nerv. cruralis* (externally,) before *fasc. iliaca* and *psoas*, passing under the crural arch.

c. *Vena cava inferior*, arises rather below the division of the *aorta*, ascends on its right side, inclines rather to the right and forwards, and passes behind the *pancreas*, before the right crus of the diaphragm into the *fossa pro ven. cava* of the liver, between *lobulus dexter* and *Spigelii*; hence through *foram. quadrilaterum* into the thorax. Its branches:

Vv. iliaca communes, pass on the right side of the corresponding arteries; the left longer, behind the origin of *art. iliaca dextra*, before *art. sacra media*.

1. *V. hypogastrica*, lies behind its artery.

2. *V. iliaca externa*, on the inner side of the artery.

d. *Vena azygos* arises before the second and third lumbar vertebra (on the right) by the junction of branches of *v. iliaca*, *renalis*, and *cava infer.* with the *lumbalis ascend.*, passes between the centre and external right *crus diaphragm.* (or through *hiatus aortic.*) into the thorax.

e. *Vena hemiazygos*, arises on the left, and takes a course like *ven. azygos*.

d. *Ductus thoracicus*, formed by two *trunci lumbales* and one *lymphatic. intestinal.*, arises before the first and second lumbar vertebra to the right of and behind *aorta abdominal.*, close to *art. mesenter. super.* (or *renal. dextra*), passes through *hiatus aorticus* into the thorax.

6. Nerves:

a. *Plexus lumbalis*; lies in and behind *m. psoas*, before *m. quadrat. lumborum*. Its continuation: *nerv. cruralis* lies in the groove between *m. psoas* and *iliacus*, under *fasc. iliaca*, at first behind; then on the outer side of *art. iliaca*.

b. *Plexus sacralis* s. *ischiadicus* lies behind *art. hypogastrica*, *ischiadicæ*, and *pudenda*, before *n. pyramidalis* at the inferior extremity of *incisura ischiadica major*.

c. *N. sympathicus*. The lumbar portion lies on the sides of the bodies of the lumbar vertebræ, the *gangl. lumbalia dextra* behind *aorta*, the *gangl. lumb. sinist.* behind *v. cava*. The sacral portion—close before the *os sacrum*; the (four) *gangl. sacralia* at the inner edge of *foramina sacral. anteriora*. *Gangl. coccygeum*, the termination of *n. sympathicus* on the anterior surface of the *sacrum*.

INDEX.

* * *The numbers refer to the antique figures.*

A.

Abdomen, 696.
 Acetabulum, 92.
 Acidum lacticum, 12; uricum, 11.
 Acini hepatis, 445; Malpighi, 470.
 Acromion, 94.
 Aditus: ad aquæduct. Sylvii, 620;
 ad cochleam, 52; ad infundibulum,
 620; ad vestibulum, 52.
 Adminiculum lineæ albæ, 261.
 Alæ Ingrassiæ (alæ minores), 48;
 magnæ, 48; nasi, 517; pterygoid.,
 48; sacrales, 79; vespertilionis,
 486.
 Albumen, 6.
 Alveoli, 66.
 Amphiarthrosis, 45.
 Ampulla chyli, 438; membranac.,
 515; ossea, 512.
 Anastomosis Jacobsonii, 511.
 Angiologia, 520.
 Angulus costæ, 85; facial. Camperi,
 73; maxillæ, 66; oculi, 492; oris,
 428; pubis, 92.
 Annulus abdominalis, 258; cruralis,
 364; digitorum, 336, 377; ingui-
 nalis, 258, 260; tympani, 52; um-
 bilical, 261.
 Ansa capitis, 52.
 Anthelix, 506.
 Antitragus, 506.
 Antrum Highmori, 59.
 Anus, 444.
 Aorta ascend., 539; descend, 570;
 abdom., 571; thorac., 570.
 Aperturæ pelvis, 93: pyriform, 69.
 Aponeuroses, 146; bicipit. 319; is-
 chio-pubica, 282; -rectalis, 282;
 palmar., 333; plantar, 596.
 Apophysis, 41.
 Apparatus ligamentos., 111.
 Appendices epiploic. s. adiposæ, 441;
 app. vermiform., 442.

Aquæductus cochl., 514; Sylvii, 620;
 vestibuli, 52, 514.
 Aquila Cotunni, 515; vitrea, 515.
 Arachnoidea, 624, 628; oculi, 499.
 Arbor vitæ cerebelli, 621; uteri, 486.
 Arcus aortæ, 540; cruralis, 256; dor-
 sal. carpi, 569; pedis, 587; glosso-
 palatin., 428; pharyngo-palatin.,
 428; plantaris, 587; pubis, 92; su-
 perciliaris, 50; tarseus infer. et su-
 per., 551; volaris carpi, 569; tarsis,
 587.
 Area Martegiani, 504.
 Areola mammæ, 489.
 Arteriæ, 524; A. acetabuli, 577, 582;
 acromialis, 561; adiposæ, 573; al-
 veolaris, 547; anonyma, 540; an-
 gularis, 551; aorta, 537; appendi-
 calis, 572; articulares genu, 583;
 aspera, 466; auditiva, 555; auricu-
 lares, 545, 546; axillaris, 560.
 B. Basilaris, 555; brachialis, 564;
 breves, 572; bronchiales, 570;
 buccinatoria, 548; bulbosa, 579.
 C. capsularis, 551; cardiaca, 539;
 carotis, 540, 550; cavernosa,
 579; centralis retinæ, 551; ce-
 rebelli, 555; cerebrealis, 552,
 555; cervicalis, 557; choroï-
 dea, 552; ciliares, 551; circum-
 flexæ femoris, 582; humeri,
 563; ilium, 581; clitoridea,
 579; cochleæ, *see* auditiva: cœ-
 calis, 572; cæliaca, 572; colica,
 572 bis; collaterales, 566 bis;
 communicans, 552; coronariæ
 cordis, 539; labiorum, 544;
 ventriculi, 572; corporis cal-
 losi, 552; cruralis, 580; cubi-
 talis, 568; cystica, 572.
 D. deferentialis, 577; dentalis,
 548, 549; digitales, 569, 587;
 dorsalis linguæ, 543; nasi, 551;
 penis (clitoridis), 579; pollicis,

- 567; scapulæ, 557; duodenales, 572.
- E. emulgentes, *see* renales: epigastrica externa, 581; inferior *seu* interna, 581; superficialis, 582; superior, 559; ethmoidales, 551.
- F. faciales, 543; f. profunda, 546; f. transversa, 546; femoralis, 582; fibularis, 586; fossæ Sylvii, 552; frontalis, 551.
- G. gastro-duodenalis. -epiploicæ, 572 bis; glutæi, 578.
- H. hæmorrhoidal. extern. s. infer. 579; interna, 572; media, 577; helicinæ, 579; hepatica, 572; hypogastrica, 576.
- I. jejunales et ileæ s. intestinales, 572; ileo-colica, 572; ileo-lumbalis s. iliaca anterior, 578; iliaca commun., 575; externa, 581; interna, 576; posterior, 578; infra-costalis, 570; infra-orbitalis, 548; infra *see* subscapularis; inguinales, 582; innominata s. anonyma: intercostales, 558, 570; interosseæ, 567, 568, 585, 587 bis; ischiadica, 579.
- L. labiales, 544, 579, 582; lacrymalis, 551; laryngeæ, 543, 556; lienal, 572; lingualis, 543; lumbales, 573.
- M. mammaria externa, 558; interna, 558; malleolares, 584, 586; masseterica, 547; mastoidea, 545; maxillaris externa, 543; interna, 546; mediastinæ, 570; meningeæ antic., 551; magna s. media, 547; parva, 547; posteriores, 545 bis, 554; mentalis, 547; mesaraica infer., 572; super., 572; metatarsæ, 585, 587; musculares oculi, 551; mylo-hyoidea, 547.
- N. nasalis, 544, 549, 551 bis; nutritia femor., 582; tibiæ, 586; ulnæ, 568.
- O. obturatoria, 577; occipitalis, 545; œsophageæ, 570; omphalo-mesaraica, 572; ophthalmica, 551; ovarica, 577.
- P. palatinæ, 544; palpebrales, 551; pancreaticæ, 572 bis; pedicæ, 585; penis, 579; perforantes, 582; pericardiacæ s. mediastinæ: phrenicæ, 573; perinaæ, 579; peronæa, 586; pharyngea ascend., 545; suprema s. vidiana: pinnales, 544; plantares, 586; poplitæa, 583; princeps pollicis, 567; profunda brachii, 566; femoris, 582; perinaei, 579 bis; penis, 579; pterygoideæ, 547; pterygo-palat., 549; publica s. pudenda, 577, 579; externa, 582; pulmonalis, 535; pylorica, 572.
- R. radialis, 567; ranina, 543; recurrens, 567, 568, 584; renalis, 573.
- S. sacci lacrymal., 551; sacra lateral., 578; media, 574; scapularis, 557; scrotales, 579, 582; septi mobil., 544; narium, 549; spermatica, 573, 581; sphenopalatina, 549; spinales, 554; spinosa, 547; splenica s. lienalis, stylo-mastoidea, 545; subclavia, 553; sublingualis, 543; submental, 544; subscapularis, 563; supraorbitales, 551; suprarenal., 573; suprascapular, 557; surales, 583.
- T. tarsæ, 551, 585, 587; temporales, 546 bis; 547; thoracæ, 561, 562; thymicæ, 558; thyreoideæ, 543, 556; tibialis, 584, 586; tracheales, 556; tonsillaris, 544; transversa cervic., 557; faciei, 546; perinaei, 579; scapulæ, 557; tubaria, 577; tympanicæ, 547, 549.
- U. ulnaris, 568; umbilicalis, 577; uterina, 577.
- V. vaginalis, 577; venosa s. pulmonalis: vertebralis, 554; vesicales, 577; vidiana, 549.
- Arthrodia, 45.
- Arthrologia, 110.
- Articulat. acromio-clavicular. 119; capit., 112; carpi, 123; carpo-carpal., 125; carpo-metacarpea, 126; costo-vertebral., 115; coxæ, 129; cubito-humeralis, cubiti, 121; digitorum manus, 128; pedis, 132; genu, 130; humeri, 120; maxillaris, 114; metatarsi, 136; radio-cubital., 122; sterno-clavicular., 118; -costal., 116; tali s. pedis, 132; tarsi, 133; tibio-fibular, 131; tibio-tarsalis, 132; vertebrarum, 111.
- Astragalus, 106.
- Atlas, 77.
- Atria cordis, 527, 528.
- Auricula, 505; cordis, 527.
- Auriculus, 506.
- Auris, 505.

B.

Balanus, 482.
 Barba s. crines.
 Bilin, 10.
 Brachia, 94.
 Bronchi, 466.
 Bronchia, 467.
 Buccæ, 428.
 Bulbus aortæ, 537; cavernos., 482;
 cinereus, 630; fornicis, 618; oculi,
 496; olfactor., 630; pili, 26; ven.
 jugular., 592; urethra, 473.
 Bursæ mucosæ s. synoviales, 148.

C.

Cacumen, 622.
 Calamus scriptorius, 618.
 Calcaneus, 106.
 Calx, 106.
 Calyces renales, 471.
 Camera oculi, 502.
 Canales: alveolaris, 66; caroticus,
 52; central. modioli, 514; cruralis,
 365; Fallopiæ, 52; Fontanæ, 497;
 incisivus, 59; infra-orbitalis, 59;
 inguinalis, 259; intestinalis, 437;
 lacrymalis, 64; palatin., 60; petiti,
 504; pterygo-palatin., 48; sacral.,
 79; Schlemmii, 497; semicircu-
 lares, 513; membranac., 515; spi-
 nalis, 80; spiralis cochl., 514; sta-
 pedii, 509; tympanicus, 52; vagi-
 nalis, 477; vertebralis, 80; vidianus,
 48; zygomaticus, 61.
 Canaliculus mastoideus, 52.
 Canaliculi lacrymales, 494.
 Canthi oculi, 492.
 Capilli s. crines.
 Capsulæ: adipose renis, 470; atra-
 biliariæ s. renes succenturiati; Glis-
 sonii, 445; lentis, 503; bulbioculi,
 496; synoviales, 110, 148.
 Caput, 46, 682; epididymid., 477;
 gallinagin., 473.
 Cardia, 436.
 Caro linguæ, 429; quadrata Sylvi,
 392.
 Carotis cerebialis, 550; facialis, 542.
 Carpus, 99.
 Cartilagines, 32, 85, 111; annularis
 s. cricoidea, 462; arytænoid., 462;
 auris, 506; dentis, 433; falcata s.
 semilunares genu, 130; fibrosæ, 32;
 formativa s. ossium, 43; nasi, 518;
 pyramidal. s. arytænoid., 462; San-
 torin., 462; scutiform. s. thyreoidea,
 462; triangular. intermed., 122 bis;
 Wrisbergian., 462.

Caruncula: lacrymalis, 493; myrti-
 formes, 487; sublingualis, 430.
 Cauda equina, 627.
 Cavitas abdominis, 724; cranii, 57,
 708; glenoidalis, 52, 94; nasi, 69;
 oris, 70, 687; pelvis, 93; thoracis,
 87, 695; tympani, 509.
 Cavum cranii, 57; dentis, 431; medi-
 astini, 468; uteri, 486.
 Cellulæ, 13; aëreæ s. pulmonales,
 467; ethmoidales, 49; lacrymales,
 49; mastoideæ, 52; medullares,
 42; nucleatæ, 13; palatinæ, 49.
 Centrum semicirculare, 620; semi-
 ovale Vieussens, 620; tendineum,
 266.
 Cerebellum, 616.
 Cerebrum, 615; abdominale, 680.
 Cerumen, 507.
 Cervix uteri, 486.
 Chiasma nerv. optic., 618.
 Choanæ, 69.
 Chordæ: longitudin. Lancisii, 619;
 tendinæ, 528; transversal. cubiti,
 122; tympani, 639; vocales s. ligg.
 vocalia, 463.
 Chorion, 484.
 Chylus, 34.
 Cilia, 492; vibratoria, 20.
 Circulatio sanguinis, 531.
 Circulus arter. Willis., 555; arter. et
 venos. irid., 500.
 Circumferentia articular., 98.
 Cisterna chyli, 601.
 Clavicula, 95.
 Clitoris, 488.
 Clivus, 48.
 Cochlea, 514.
 Cœcum, 442.
 Coles s. penis, 482.
 Colla, 8.
 Colliculi: n. optici, 501; seminalis,
 473.
 Collum vesicæ urinariæ, 472.
 Colon, 443.
 Columella, 514.
 Columnæ fornicis, 619; rugarum
 recti, 444; vaginæ, 487; vertebra-
 lis, 74.
 Commissuræ: alba, 627; anterior,
 620; cinerea, 627; labior. pudend.,
 488; cerebri magna, 619; mollis,
 620; posterior, 620.
 Conarium, 619.
 Conchæ: auris, 506; inferiores nasi,
 64; mediæ Morgagni, 49.
 Condylus femoris, 102; humeri, 96;
 maxill. inf., 66; occipital., 47; sca-
 pulæ, 94; tibiæ, 103; ulnæ, 97.

Confluens sinuum s. torcul. Hero-
phili, 625.
Conjunctiva, 492, 497, 498.
Conus medullaris, 627; vasculos.
Halleri, 477.
Cor, 527.
Corium, 39.
Cornea, 498; opaca, 497.
Cornicula Santorini, 462.
Cornua: ammonis, 620; Bertini, 48;
coccygea, 80; hyoid, majora et
min., 67; limacum, 494; sacralia,
79.
Corona ciliaris, 504; glandis, 482.
Corpora: bigemina, 619; callosum,
619; candicantia s. albicantia s.
mammillaria, 618; cavernos. penis,
482; urethræ, 473; ciliare, 499;
geniculata, 618, 620; Highmori,
477; luteum, 483; mamillaria, 614,
618; olivaria, 618; pyramidalia,
618; quadrigemina, 619; restifor-
mia, 618, 623; rhomboideum, 621;
striatum, 620; trigonum, 471; vi-
treum, 504.
Corpuscula triticea, 67; lienis, 451;
Pacinian., 612.
Costæ, 85.
Coxa, 89.
Cranium, 53.
Crines, 26.
Cristæ: frontales, 50; galli, 49; ilei,
90; lacrymalis, 63; nasalis, 59, 62;
occipitales, 47; sphenoidalis, 48;
turbinalis, 60; pyramidalis, 512.
Cruor, 36.
Crura cerebelli, 618, 621; cerebri,
618, 620; diaphrag., 266; fornicis,
619; gland. pineal., 619; medull.
oblongat., 618, 621; uteri, 486.
Crus, 103.
Cryptæ Lieberkühnian., 441; seba-
cæ s. follicul. sebac., 39.
Cubitus s. ulna.
Culmen, 622.
Cunnus, 488.
Cupula, 514.
Cutis, 39.
Cystis fellea, 447.
Cytoblastema, 13.
Cytoblastus, 13.

D.

Dartos, 476.
Declive, 622.
Dentes, 431.
Dentitio, 433.

Descensus testiculi, 477.
Detrusor urinæ, 472.
Diaphragma, 266.
Diaphysis, 41.
Diarthrosis, 45.
Didymi, 477.
Digiti manus, 101; pedis, 108.
Diploë, 42.
Discus proligerus, 484.
Diverticulum Vateri, 439.
Dorsum s. columna vertebral., 74.
Ductus arter. Botall., 535; Bartholin.,
430; biliferi, 445; choledochus,
449; cysticus, 448; deferens, 478;
ejaculatorius, 479; hepaticus, 446;
naso-lacrym., 494; lactiferi, 489;
pancreaticus s. Wirsungianus, 450;
Rivianiani, 430; Stenonianus, 430;
thoracicus, 601; venos. Arantii, 445;
Whartonianus, 430.
Dura mater encephali, 624; medull.
spinal., 628.

E.

Eminentia: arcuata, 52; capitata,
96; ileo-pectinea, 92; carpi, 99;
intermedia, 103; pyramidalis s. pa-
pillaris, 509; eminentia teretes,
623.
Emissaria Santorini, 625.
Enarthrosis, 45.
Encephalon, 614.
Endocardium, 528.
Ephippium, 48.
Epidermis, 39.
Epididymis, 477.
Epigastrium, 696.
Epiglottis, 462.
Epiphysis s. ossa.
Epiploon, 457.
Epistropheus, 77.
Epithelium, 19.
Excavatio ischio-rectalis s. fossa peri-
næ: recto-uterina, 453; recto-ve-
sical, 453; vesico-uterina, 453.
Extremities abdominales s. inferi-
ores, 102; thoracica s. superiores,
94.

F.

Facies s. ossa faciei: auricular., 79,
90; lunata, 92.
Falx cerebelli, 624; cerebri, 624.
Fascia, 146; abdominales, 267; ani
s. perineal., 283; antibrachii, 319;
brachii, 298; bucco-pharyngea, 181;

bulbi s. capsula bulbi, 496; cervicalis, 210; clavicularis, 219; communis superf., 146; cruralis, 379; cubiti, 319; dentata, 620; femoris s. lata, 361; iliaca s. lumbo-iliaca, 349; ilio-pubica, 349; lata, 361; lumbo-dorsalis, 252; dorsalis manus, 334; nuchæ, 252; palmaris s. aponeuros.: parotideo-masseteric., 180; pedis, 396; pelvis, 284; perinæ, 281, 283; plantaris, 396; præ-vertebral., 211; subscapularis, 291; supra-spinata, 291; superficialis abdom., 267; pector., 219; temporalis, 179; transversal. abdom., 268.

Fasciculus unciformis, 623.

Fauces, 434.

Fel, 10.

Femur, 102.

Fenestra cochleæ s. rotunda, 509; ovalis s. vestib., 509.

Fibro-cartilagines s. cartill. fibross.

Fibula, 104.

Filamenta: terminal. medull. spin., 628.

Fimbria, 620; tubæ Fallop., 485; linguæ, 429.

Fissura: Glaseri, 52; orbital. infer., 48; super., 48, 57; sphenoidal. s. speno-maxillar., 48.

Fistula sacra s. medulla spinal.

Flocculus, 621.

Focile majus s. ulna, minus s. radius.

Folium cacuminis, 622.

Folliculi dentium s. dentes, Graafiani, 484; mucosi, 40; pilorum, 26; sebacei, 39.

Fonticuli, 55.

Foramina: alveolar. infer., 66; poster., 59; centrale retinæ, 501; cæcum, 49; c. linguæ, 429; condyloidea, 47; cribrosa, 49; ethmoidalia, 49, 50; incisivum, 59; infraorbitale, 59; interruptum, 48; intervertebralia, 75; jugulare, 47; lacrum anter. poster., 52, bis, 57; magnum occipitale, 47; mastoid., 52; maxillare (poster.), 66; Meibomii s. cæcum linguæ, mentale, 48; Monroi, 620; obturatorium, 92; œsophageum, 266; opticum, 48 bis; orbitalia s. ethmoid., ovale, 48, 92; ov. cordis, 528; parietale, 51; pterygo-spinosum, 48; quadrilaterum, 266; rotundum, 48; spenopalatin., 60; spinale, 75; spinosum, 48; stylomastoid., 52; supraorbitale, 50; Thebesii, 528; vertebrale, 77; Winslowii, 452; zygomat., 61.

Fornix, 619; cranii, 57; vaginæ, 487.

Fossæ: articulares patellæ., 105; (bulbi v.) jugular., 47; cerebelli, 47; cerebrum, 47; condyloideæ, 47; cochlea, 52; cranii, 57; cubiti s. sigmoid., ductus venosi, 445; gland. lacrymal., 50; humeri, 96; hyaloidea, 504; iliaca, 93, 699; iliopectinea, 365; infra-claviclar., 703; infraspinata, 94; inguinalis, 453; innominata, 506; intercondyloideæ, 102; lacrymal., 63; longitudin. hepat., 445; malleoli, 104; pro medulla obl., 47; Morgagni, 473; navicular., 473, 488; auris s. scapha: ovalis, 528; parietalis, 51; perinæ, 282; poplitæa, 102, 705; pterygoidea, 48; pterygo-palatina, 72; pulmonales, 87 bis; sigmoidea, 98; speno-maxillar., 72; supraclaviclar., 211; supraspinata, 94; Sylvii, 615; temporales, 57; transversa hepatis s. porta; trochantetica, 102; trochlearis, 50; umbilicalis, v. cavæ: vesicæ fell., 445; vestibuli, super., infer., 52; zygomat., 71, 690.

Fossula petrosa, 52.

Fovæ: acetabuli, 92; axillaris, 702; inguinales, 453; lacrymal., 50, 68; maxillaris, 59; ovalis, 365.

Frenula: clitoridis, 488; labiorum, 428, 488; linguæ, 429; Morgagni, 440; valvul. cerebell. anter., 622.

Funiculus spermaticus, 478; umbilicalis s. art. and ven. umbilic.

G.

Galea aponeurotica, 150.

Ganglia, 611; Arnoldi, 637; auriculare, 637; cardiacum, 672, 673, 674; caroticum, 672; cerebri, 620; cervicalia, 671, 673, 674; ciliare, 635; coccygeum, 678; Casseri, 634; geniculatum, 639; glotticum, 637; incisivum, 636; intercaroticum, 672; jugularia: Mülleri, 641; n. vagi, 643; linguale, 637; lumbalia, 676; maxillare, 637; Meckelii, 636; naso-palatinum, 636; ophthalmicum, 635; oticum, 637; petrosum, 636; rhinicum, 636; sacralia, 677; semilunare, 680; spenopalatinum, 636; spinalia, 649; temporale, 672; thoracica, 675; thyroideum, 673.

Genæ, 428.

Genetalia muliebra, 483; virilia, 475

Genu corpor. callosi, 619; n. facial, 639.
 Gingiva, 432.
 Ginglymus, 45.
 Glabella, 50.
 Glandebalæ, 26.
 Glandulæ, 37; Bartholinianæ, 488; Brunnerian, 438; buccales, 428; ceruminos, 507; Cowperi, 479, 488; Duverneianæ, 488; epiglottica, 462, 464; Haversian, 110; labiales, 428; lacrymales, 494; lactiferæ s. mammaræ; lenticular. ventric., 436; Lieberkühn., 438; Littrii, 473; Meibomii, 493; mucosæ, 37; molares, 428; odoriferæ s. Tysonianæ, 482; palatinæ, 428; parotis, 430; Peyrierian, 438; pinealis, 619; pituitaria, 618; præputiales, 482; prostata, 480; solitariae intestinal., 438, 439; salivales, 430; sublingualis, 430; submaxillar, 430; suprarenales, 474; tartaricæ, 37; thymus, 469; thyreoidea, 465; tracheales, 466; tubulosæ, 37.
 Glandulæ lymphaticæ: aorticæ, 603; axillares, 605; brachiales, 605; bronchiales, 605; cervicales, 605; celiacæ, 604; cubitales, 605; duodenales, 604; faciales, 605; gastro-epiploicæ, 604; hepaticæ, 604; hypogastricæ, 603; iliace extern., 603; inguinales, 603; intercostales, 605; Littrii, 473; lienales, 604; lumbales, 603; mastoideæ, 605; maxillares internæ s. submaxillar., 605; mediastinæ anter. et post., 605; mesentericæ, 604; mesocolicæ, 604; occipitales, 605; pancreaticæ, 604; parotidæ, 605; popliteæ, 603; pulmonicæ, 605; sacrales, 603; subauriculares, 605; submaxill., 605; substernales, 605; tracheales s. bronchiales; tibialis antic., 603; Vesalian, 605; zygomatice, 605.
 Glans clitorid., 488; penis, 482.
 Glomeruli Malpighii, 470.
 Glottis, 463.
 Gubernaculum Hunteri, 477.
 Gyri breves, 615; gyrus fornicatus, 615, 623.

H.

Habercula, 478.
 Hallux, 108.
 Hamulus lacrymal., 63; oss. hamati, 99; pterygoid, 48.

Harmonia, 45.
 Helix, 506.
 Hemisphæria cerebri, 614; cerebelli, 616.
 Hepar, 445.
 Hiatus aorticus, 266; canal. Fallop., 52.
 Hilus lienis, 451; ovarii, 483; pulmon., 467; renis, 470.
 Hippocampus, 620.
 Histologia, 1.
 Humerus, 94.
 Humor aqueus, 502; vitreus, 504.
 Hymen, 487.
 Hypogastrium, 699.
 Hypophysis cerebri, 618.

I.

Jecur, 445.
 Jejunum, 440.
 Ileum, 440.
 Impressiones digitatæ, s. cranium.
 Incisuræ: ischiadica major, minor, 91; pterygoidea, 48; Santorini, 507; sigmoidea, 66; supraorbitalis, 50.
 Incus, 510.
 Index, 101.
 Infundibulum, 471; inf. cerebri, 618.
 Inscriptiones tendineæ s. m. rectus abdom.
 Insula, 615.
 Integumenta communia, 38, 39.
 Intercilia, 491.
 Interstitium jugulare, 692.
 Intestinum amplum s. crassum, 441; augustum s. tenue, 438.
 Introitus vaginæ, 487.
 Intumescencia ganglioform. n. facial, 639.
 Iris, 500.
 Irritabilitas Halleri, 143.
 Isthmus faucium, 428; urethræ, 473; Vieussensii, 528.
 Jaga alveolaria, 59, 66; cerebralia, 51.
 Jugulum, 692.
 Julius, 428.
 Junctura ossium, 45.

L.

Labia, 428; orificii uteri, 486; pudendi majora, 488; minora, 488.
 Labra: glenoidea s. cartil., 110; acetabuli, 129; humeri, 120.

- Labyrinthus membranaceus, 515; os-seus, 512; oss. ethmoid., 49.
 Lacertus Weitbrechti, 112.
 Laciniae plantares, 395; l. s. fimbr. tub. Fallop., 485.
 Lacunæ s. cryptæ, 473.
 Lacunar orbitæ, 68.
 Lacus lacrymalis, 494.
 Lamellæ ossium, 42.
 Laminæ: cribrosa cerebri, 618; fasc. femoris, 365; oss. ethmoid., 49; scleroticae, 497; papyracea, 49; spiralis, 514; terminalis, 514; vitrea, 57.
 Lanugo, 26.
 Laqueus, 623.
 Larynx, 461.
 Lema, 493.
 Lemniscus s. corp. ciliare cerebelli.
 Lens crystallina, 503.
 Lien, 451.
 Lienculus, 451.
 Ligamenta, 110; accessor. obliquum, rectum Weitbrecht, 112; alaria genu, 130; Maucharti, 112; apicum, 111; arcuatum, 117; arteriosum, 535; ary-epiglottica, 463; auriculæ, 506; capsulare sacciforme, 122 bis; ciliare, 499; conoideum, 119; coronar. hepatis, 455; coruscantia, 116; crico-arytænoid., 463; -thyreoid., 463; -tracheal., 463; cruciat. atlantis, 113; -digitorum, 336; -genu, 130; tarsi, 381; deltoideum, 132; denticulatum, 628; duodeno-colicum, d.-renale s. peritonæum; Epididymis, 477; Fallopiæ, 256; flava, 111; fundiforme tarsi, 381; gastro-colicum, gastro-hepaticum, gastro-lienale s. peritonæum; Gimbernati, 257; glenoidæum, 120; glosso-epiglottica, 464; glottidis, 463; hepatico-colicum, -duodenale, -gastricum, -renale s. peritonæum, Hunteri s. Gubernacul.; hyo-epiglotticum, 462; hyo-thyreoidæa, 463; ilio-lumbalia, 117; ilio-pectineum s. fasc. iliaca; ilio-sacra, 117; inguinale s. fasc. transvers.; intercartilaginea s. cartil.; intervertebr., 111; interlobularia, 468; intertransversalia, 111; lacinata, 383; laryngis, 463; longitudinalæ anter., 111; poster., 111; mallei, 510; mucosa genu, 130; nuchæ, 111; obturatorium, 117; obt. atlant., 112; ossicul. auditus, 510; ovarii, 483; palpebralia, 492; patellæ, 130; phrenico-gastrica, -lienale s. peritonæum; pelvis, 117; perinæale, 283; poplitæum, 130; Poupartii, 256; pubo-prostatica, 482; -vesicalia, 284, 472; pulmonis, 468; pyramidalia s. artic. carpi; radiatum extern., 116; rhomboid. carpi, 123; claviculæ, 118, 119; sacro-coccygea, 117; sacro-ischiadica, 117; serosa s. periton., serratum, 628; spinoso-sacrum, 117; stylo-hyoideum s. musc.; stylo-maxillare, 114; subcruentum, 122 bis; subflava, 111; suspens. dentis, 112; -penis, 482; -hepatis, 445; -vesicæ, 453; triangularia, 455; teres, 129, 445; trapezoideum, 119; tuberoso-sacrum, 117; uteri lata, 486; -rotunda, 486; vaga, 117; Valsalvæ, 506; vesicalia, 472; vocalia, 463.
 Limbus alveolaris s. process. alv., 66.
 Linæ: alba, 261; arcuatæ, 90; aspera, 102; intertrochanterica, 102; semicircularis, 47, 50, 51, 57; obliquæ, 66, 462; transversæ occipitis, 47; palat., 60; turbinatæ, 59.
 Lingua, 429.
 Lingula, 622.
 Liquor sanguinis et lymphæ, 33.
 Liquor Morgagni, 503.
 Lobulus anonymus hepatis, 445; auriculæ, 506; biventer s. cerebellum; caudatus s. quadratus, 445; Spigellii s. hepar; tener s. cerebellum.
 Loculamenta, 442.
 Lunula, 23.
 Lymphæ, 34.
 Lyra, 619.
- M.
- Maculæ cribrosæ, 512; lutea, 501; germinativa, 484.
 Malleolus extern., 104; intern., 103.
 Malleus, 510.
 Mammæ, 489.
 Mandibula, 66.
 Manubrium mallei, 510; sterni, 84.
 Manus, 99.
 Margo ciliaris iridis, 500.
 Massa explementi, 623.
 Massæ laterales, 77.
 Matrix pili, 26; unguis, 23.
 Maxilla inferior, 66; super., 59.
 Meatus auditor. extern., 52, 507; intern., 52; narium, 519.
 Mediastina, 463.

- Meditullium album, 623.
 Medulla oblongata, 618; ossium, 42; spinalis, 627.
 Membranæ: adamantina, 431; capsulo-pupillaris, 503; Descemetii, 498; fenestræ rotundæ, 509; granulosa, 484; humor. aquei, 498; hyaloidea, 504; interossea cruris, 131; medullaris, 42; nictitans, 492; obturatoria s. Ligg.; oss. sacri propria, 117; pigmenti, 499; pituitaria, 519; pulposa palati, 428; pupillaris, 503; Ruyschiana, 499; Schneideriana, 519; sterna propria, 116; suprachoroidea, 498; thyreo-hyoidea s. lig.; tympani, 508; secundaria, 509; vitellina s. chorion; Wachen-dorfiana, 503.
 Membrum virile, 482.
 Menisci, 114.
 Meninx arachnoidea, 624; dura, 624; pia, 624.
 Mentum, 66.
 Mesencephalon, 617.
 Mesenteriolum appendicis, 442; testiculi s. mesorchium.
 Mesenterium, 459.
 Mesocæcum, 459.
 Mesocolon, 459; -transvers., 458.
 Mesorchium, 477.
 Mesorectum, 459.
 Metacarpus, 100.
 Metatarsus, 107.
 Modiolus, 514.
 Mons cerebelli, 622; Veneris, 482, 488.
 Monticulus cerebelli, 622.
 Mordices s. dentes.
 Morsus diaboli, 485.
 Mucro cordis, 527; sterni, 84.
 Musculi, 141.
 A. abdominales, 253, 254, 255, 262, 263; abducens, oculi, 495; abductor digit. minimi, 326, 389; hallucis, 385; pollicis, 315, 322; accelerator urinæ, 277; adducens oculi, 495; adductores femor., 357, 358, 359, 360; hallucis, 387; pollicis, 325; amatorius, 495; anconæi, 295, 296; anisclaptor s. anitersor, 222; antagonistæ, 145; antitragicus, 154, 506; ary-epiglotticus, ary-tænoid., 464; attollens auricul., 151; humeri, 285; oculi, 495; auriculares, 151; azygos uvulæ, 200.
 B. baseo-glossus, 194; bibitorius, 495; biceps brachii, 292; femoris, 350; biventer cervic., 232; maxillæ, 188; brachialis intern., 293; extern., 295; buccinator, 163; bucco-pharyngeus, 196; bulbo-cavernos., 277.
 C. caninus, 166; capitis, 149; cerato-glossus, 194; cerato-pharyngeus, 196; cervical. descend., 236; chondro-glossus-pharyng., 194, 196; circumfl. palati, 199; coccygeus, 272; complex. cervic., 233; compressor narium, 159; constrictor cunni, 278; isthmi faucium, 201; pharyngis, 196; urethræ, 277; coraco-brachialis, 294; -cervicalis, 185; corrugator superciliaris, 156; costo-clavicul., 214; cremaster, 264; crico-ary-tænoid., -thyreoid., 464; -pharyngeus, 196; crotaphytes, 175; cruralis, 355; cucullaris, 221; curvator coccygis, 273.
 D. deltoideus, 285; depressor alæ nasi, 158; anguli oris, 169; labii inferior., 171; septi mobil., 162; vesicæ, 280; digastricus maxill., 188; dilatores narium, 160; conchæ, 506.
 E. ejaculator. semin. s. accelerator; epicranius, 149; erector clitorid., penis, 276; extensores carpi, 309, 310; coccygis, 274; cruris, 355; -digitorum commun. 312, 368; digit. min., 313; dorsi, 237; halluc., 367, 378, 384; indicis, 318; pollicis, 316, 317.
 F. fascialis, 353; flexores carpi, 301, 303; digitor. commun., 304, 305, 377, 391; digit. min., 327, 390; femoris, 337; fibularis, 350; hallucis, 386; pollicis, 306, 324; radii, 292; frontalis, 150.
 G. gastrocnemius, 372; gemelli, 345, 346; genio-glossus, 195; -hyoideus, 191; -pharyngeus, 196; glosso-palatin., 201; glutæi, 340, 341, 342; gracilis, 356.
 H. helcis, 506; hipicus, 366; Horneri, 494; hyo-glossus, 194.
 I. iliacus, 338; ilio-costalis, 238; incisivi, 158, 172; indicator, 318; infracostales, 217; infrapinat., 287; intercostales, 216; interossei, 331, 332, 394, 395; interspinales, 249; intertransversales, 250; ischio-cavernos., 271; -coccyg., 272.

- L. latissim. colli, 182; dorsi, 222; laxator tympani, 510; levator anguli oris, 166; -scapulæ, 226; -ani, 275; costarum, 243; -labii super., 164, 165; -menti, 172; -palpebræ, 157; -palati, 198; penis, 276; -pharyng., 197; linguales, 192; longissim. dorsi, 237; longus colli, 203; lumbicales, 330, 393.
- M. mallei, 510; mnsiores, 174; masseter, 174; multifidus, 248; mylo-hyoideus, 190; -pharyngeus, 196.
- N. nauticus, 376; nutator capitis, 183.
- O. obliqui abdomin., 253, 254; capitis, 246, 247; oculi, 495; obturatores, 344, 345; occipit., 149; omohyoideus, 185; orbicularis oris, 162; palpebrar., 155; opponens digit. min., 328; pollic., 323.
- P. palato-staphylin., 200; palmaris brevis, 329; longus, 302; papillaris, 528; patheticus, 495; pectinæus, 357; pectorales, 212, 213; pedicæus, 384; perinæus, 271; peristaphylini, 198; peronei, 369, 370, 371; pharyngei, 196; pharyngo-palatinus, 202; pyriformis, 343; plantaris, 373; platysmamyoid., 182; poplitæus, 375; procerus, 161; pronator quad., 307; teres, 300; protractor s. sphincter ani; protrahens auricul., 152; psoas major, minor, 337, 338; pterygoidei, 176, 177; pterygo-pharyngeus, 196; pubo-cavernosus, 277; pyramidalis, 161, 263.
- Q. quadratus femor., 347; lumborum, 265; menti, 171.
- R. radialis intern., 301, 309; brevis, 310; longus, 309; rectus abdominis, 262; recti capitis, 204, 205, 206, 244, 245; -femoris, 355; -internus s. gracilis; -oculi, 495; reflector epiglottid., 464; rhomboidei, 227, 228; retrahentes auriculæ, 153; risorius, 170; rotatores dorsi, 251.
- S. sacci lacrymalis, 494; sacro-coccygei, 273, 274; sacro-lumbalis s. ilio-costalis; sartorius, 354; scaleni, 207, 208, 209; semimembranos., 352; semi-spinalis cervicis, 242; -dorsi, 241; semitendinosus, 351; serrati antici, 215; postici, 229, 230; soleus, 374; spheno-salpingostaphylin., 199; sphincter ani, 270; -oris, 162; -palpebrarum, 155; spinalis cervicis, 240; dorsi, 239; splenius capitis, 224; colli, 225; sternocleido-mastoideus, 183; sternohyoideus, 184; -thyreoideus, 186; stylo-glossus, 193; stylo-hyoid., 189; stylo-pharyngeus, 197; subanconeus, 297; subclavius, 214; subcostales s. infracost., 239; subcruralis, 355; subscapularis, 290; superbus, 495; supinatores, 308, 311; supracostales s. levatores cost.; supra-spinatus, 286.
- T. temporalis, 175; tensor fasciæ lat., 353; palati, 199; teretes, 288, 289; tibialis antic., 366; postic., 376; thyreo-arytænoid., 464; -hyoideus, 187; thyreoideus, 187; thyreo-pharyngeus, 196; trachelo-mastoid., 234; tragicus, 506; transversal. cervicis, 235; menti, 173; pedis, 388; transversus abdomin., 255; auriculæ, 506; mandibulæ, 190; nasi, 159; perinæi, 271; prostata, 480; trapezius, 221; triangularis menti, 169; sterni, 218; triceps brachii, 295; femoris, 358; suræ, 372.
- U. ulnaris extern., 314; intern., 303.
- V. vasti, 355; vesicales, 280.
- Z. zygomatici, 167, 168.
- Mutatio dentium, 433.
- Myologia, 141.
- Mystax, 428.
- N.
- Nares, 517.
- Nasus, 516.
- Nates s. clunes.
- Nervi, 611.
- A. abducens, 638; accessorius Willisii, 647; acusticus s. auditorius, 640; alveolar. anter., 636; infer., 637; poster., 636; super., 636; auricularis anterior, 637; magnus, 653; n. vagi, 643; poster., 639; superior, 653; auriculo-temporalis, 637; axillaris, 660.

- B. brachiales, 658; buccales, 639; buccinatorius, 637.
- C. cardiaci sympathici, 672, 673, 674; vagi, 644, 645; carotico-tympanici, 671; caroticus, 671; cerebrales, 629; cervicales, 650; ciliares, 635; circumflexus humeri, 660; coccygei, 668; cochleæ, 515, 640; communicans faciei, 639; fibulæ, 667; tibiæ, 667; communicantes faciales, 639; crotaphitico-buccinator, 637; cruralis, 665; cubitalis, 660; cutanei abdominis, 661; antibrachii, 659; brachii, 659; cruris, 667; dorsi pedis, 667; femoris, 665, 667; glutæi, 667; pectoris, 661.
- D. dentales, 636, 637; diaphragmaticus, 654; digastricus, 639; divisus, 634; dorsales, 661; -clitoridis penis, 667; -scapulæ, 657.
- E. ethmoidalis, 635.
- F. facialis, 639; faciales, 639; femoralis, 665; fibularis, 667; frontales, 635.
- G. genito-cruralis, 664; glosso-pharyngeus, 641; glutæi, 667; gustatorius, 637.
- H. hæmorrhoidales, 667; hypoglossus, 648.
- I. ileo-hypogastricus, 664; ileo-inguinalis, 664; indignatorius, 639; infra-occipitalis, 653; infraorbitalis, 636; infrascapularis, 657; infraspinalis, 657; infratrochlearis, 635; inguinalis, 664; intercostales, 649, 661; interossei, 660; ischiadicus, 667; Jacobsonii, 641; jugularis, 671.
- L. labiales, 636, 667; lacrymalis, 635; laryngei, 644, 645; lingualis, 637, 641; lumbales, 662; lumbo-inguinales, 664.
- M. mandibularis, 637; marginalis, 639; massetericus, 637; masticatorii, 637; maxillaris superior, 636; maxillaris inferior, 637; meatus auditorius externus, 367; medianus, 660; mentalis, 637; molles, 672; muscularis, 660, 665; musculo-cutaneus, 659; mylohyoideus, 637.
- N. nasales, 635, 636 bis; nasociliaris, 635; naso-palatinus, Scarpæ, 636.
- O. obturatorius, 665; occipitales, 652, 653; oculo-motorius, 632; œsophagei, 645; olfactorius, 630; ophthalmicus, 635; opticus, 631.
- P. palatini, 636; palpebrales, 636; patheticus, 633; pectorales, 657, 661; perforans Casserii, 659; perinaei, 667; peronei, 667; petrosi, 636, 641, 671; pharyngei, 644; phrenici, 654; plantares, 667; pneumogastricus, 642; poplitæi, 667; pterygoidei, 637; pterygo-palatinus, 636; pudendi, 667.
- R. radialis, 660; recurrens, 636, 645; renales, 679; respiratorius, 657.
- S. sacrales, 666; sapheni, 665, 667; scapularis, 657; scrotales, 667; septi narium, 636; spermaticus, 664, 667; sphenopalatinus, 636; spinales, 649; splanchnici, 679; subclavius, 654; subcutanei: colli, 653; clunium, 667; femoris, 667; glutæii, 667; malæ, 636; maxillæ infer., 637; nasi, 636; perinaei, 667; suboccipitalis, 651; subscapularis, 657; supraclaviculares, 654; supraorbitalis, 635; suprascapularis, 657; supraspinatus, 657; supratrochlearis, 635; sympathicus, 669.
- T. temporales, 637 bis; tentorii cerebelli, 633; thoracici, 657, 661; tibiales, 667; tracheales, 645; trigeminus, 634; trochlearus, 633; tympanicus, 637, 641.
- U. ulnaris, 660.
- V. vagus, 642; vestibuli, 515, 640; vidiani, 636, 671.
- Z. zygomatici, 635, 639.
- Neurilema, 29, 611.
- Neurologia, 606.
- Nodus Arantii, 528; Malacarne, 622.
- Nucleus caudatus, 623; cerebelli, 623; dentis, 432; lenticularis, 623; lentis, 503; tæniæformis, 623.
- Nymphæ, 488.
- O.
- Occiput, 47.
- Oculus, 490.
- Œsophagus, 435.
- Olecranon, 97.
- Omentum majus, 457; minus, 457.

- Omoplata, 94.
 Ora serrata, 504.
 Orbiculus ciliaris, 499.
 Orbita, 68.
 Orchides, 477.
 Organa: auditus, 505; digestionis, 427; genitalia, 475; gustus, 429; lacrymalia, 494; olfactus, 516; respirationis, 460; sensoria, 490; sudoripara, 39; uropoetica, 470; visus, 490; vocis, 461.
 Os, 428; tinea, 486.
 Ossa, 41; antibrachii, 97; basilare, 47; brachii, 96; bregmatis, 51; capitatum, 99; capitis, 46; coxæ, 89; coccygis, 80; cranii, 46; cribriforme, 49; cruris, 103; cuboideum, 106; cuneiformia, 106; cylindrica, 41; ethmoideum, 49; faciei, 58; femoris, 102; frontale, 50; hamatum, 99; humeri, 96; hyoideum, 67; ilium, 90; innominata, 88; intermaxillare s. incisivum, 59; ischii, 91; jugale, 61; lacrymale, 63; linguale, 67; lunatum, 99; malle, 61; manus, 99; maxillare, 59, 66; multangulum majus, 99; minus, 99; nasal, 62; naviculare, 99, 106; occipitis, 47; palatina, 60; parietalia, 51; pectoris, 84; pedis, 106; petrosus, 52; pisiforme, 99; pubis, 92; pyramidale, 99; sacrum, 79; scaphoideum, 99, 106; sesamoidea, 101, 108; sphenoida, 48; temporum, 52; trapezoides, 99; triquetrum, 99; turbinata, 64; unciniforme s. hamatum; unguis, 63; zygomatica, 61.
 Ossicula auditus, 510; Bertini, 48; episternalia, 84; lenticulare, Sylvii, 510; Wormiana, 47.
 Osteogenesis, 43.
 Osteologia, 41.
 Otoconia s. otolithi, 515.
 Ovaria, 483.
 Ovula Nabothi, 486; Graafiana s. vesicul.
 Ovulum, 484.

 P.
 Palatum durum, 428; mobile, 428.
 Palpebræ, 492.
 Pancreas, 450.
 Panniculus adiposus, 30.
 Papillæ calicinæ, capitatæ, clavatæ, conicæ, 429; corii, 39; filiformes, fungiformes, 429; foliata, 429; lenticulares, 429; linguæ, 429; mammae, 489; renalis, 470; truncatæ, vallatæ, 429.
 Pappus, 428.
 Parastata, 477.
 Parotis, 430.
 Patella, 105.
 Pecten, 92.
 Pectus, 83.
 Pedunculi cerebri, 623.
 Pelvis, 88, 93; renalis, 471.
 Penis, 482.
 Pericardium, 530.
 Perichondrium, 29, 32.
 Pericranium, 57.
 Periglottis, 429.
 Perimysium, 142.
 Perinæum, 701.
 Periorbita, 68.
 Peristœum, 29, 42.
 Peritoneum, 452.
 Perone s. fibula.
 Pes, 106; anserinus, 351; hippocampi major, 620; minor, 620.
 Phalanges, 101, 108.
 Pharynx, 434.
 Philtrum, 428.
 Pia mater, 29, 626, 628.
 Pigmentum nigrum s. acinosum, 24.
 Pili, 26.
 Pinguedines, 12.
 Pinnæ nasi, 517.
 Placenta lymphæ et sanguinis, 35, 36.
 Planum semicirculare, 51.
 Pleura, 468.
 Plexus: anserinus s. nerv. facialis; lymphatici s. vasa lymphat., 601; venosus pampiniform., 596; spinales, 600.
 Plicæ conniventes Kerkring., 438; cubiti, 704; inguinalis, 699 bis; palmatæ, 486; pubo-umbilicales, 453; recto-uterin. s. periton.; semilunaris conjunctiv., 492; Douglas. s. periton.; urachi, 453; uretericæ, 472; vesico-uterin. s. periton.
 Pollex, 101.
 Pomum Adami, 462.
 Pons Sylvii, 619; Varolii, 618.
 Porta hepatis, 445.
 Portio dura, 639; mollis n. vii., 640; intermed. Wrisberg. s. nerv. facialis, 639.
 Porus acusticus s. meatus auditor.
 Præputium clitorid., 488; penis, 482.
 Processus: alveolaris, 59; anconæus, 97; anonymus, 47; ciliares, 499; clinoides, 48, 57; cochlearis, 509; condyloid., 47, 66; coracoideus, 94;

coronoideus maxill., 66; ulnæ, 97; cubitalis s. ancon., 97; ensiformis, 48, 84; ethmoidalis, 65; folianus, 510; falciform. major et minor, 624; fasciæ latæ, 365; frontalis maxill. sup., 59; oss. zygomatic., 61; geni, 66; incudis, 510; jugularis, 47; lacrymalis, 64; mallei, 510; mammillaris, s. mastoideus, 52; maxillar., 64; nasalis, 59; obliqui, 75; odontoides, 77; orbitalis, 60; oss. zygomatic., 59; palatinus, 59; pterygoideus, 48; pyramidalis, 60; sphenoidal., 60; spinosus, 48, 75, 76; styloidei, 52, 97, 98; temporalis, 61; transversi, 75, 76; uncinatus, 49, 99; vermiformis, 442; xyphoides, 84; zygomatichi, 50, 52.

Prolabia, 428.

Promontorium, 79, 509.

Pronatores, 145.

Prostata, 480.

Protuberantia annularis, 616, 618; occipitalis, 47.

Psalterium, 619.

Ptyalin, 7.

Pubes, 26, 476, 488.

Pudendum, 488.

Pulmones, 467.

Pulpa dentis, lienis, pili, testis (which see).

Punctæ lacrymalia, 494.

Pupilla, 500.

Pylorus, 436.

Pyramides Ferreinii, 470; Malpighi, 470.

Pyramis vermis, 622.

R.

Radiatio medullaris, 623.

Radius, 98.

Radix pulmonis, 467.

Ramus maxill. infer., 66; Jacobsonii, 641.

Raphe corp. callos.; pharyng.; perinæi et scrotii (which see).

Receptaculum chyli seu Pecqueti, 601.

Recessus hemielliptic., hemisphæric., 512; vesic. urinar. (see these).

Rectum, 444.

Regio analis, 701; costalis, 694; epigastrica, 696; hypogastrica, 699; inguinalis, 699 bis; laryngea, 692; lumbalis, 698; malaris, 687; mammillares, 694; mastoidea, 685; mesogastrica, 697; nasalis, 686; occi-

pito-frontalis, 682; orbital., 689; parotid., 691; perinæi, 701; sternal., 694; sterno-mast., 693; supraclavicul., 693; suprahyoid., 692; thyreoid., 692; temporal., 683; tonsillar., 687; umbilical., 697; urogenitalis, 701.

Ren, renulus, 470; succenturiat., 474.

Rete articulare cubiti, 568; carpeum dorsalis, 569; genu, 583; malleolare, 586; Malpighii s. epidermis; mirabile, 522; vasculos. Haller., 477.

Retina, 501.

Retinaculum tendin., 146.

Rigor mortis, 143.

Rima glottidis, 463; valvæ, 488.

Rostrum lamin. spir., 514; sphenoidal., 48.

Rotatio, 45.

Rotatores, 145.

Rotula s. patella, 105.

Rugæ transvers., 429; longitudinal., 485.

S.

S. romanum, 443.

Saccarum lactis, 12.

Sacculus oblongus, rotundus, 515.

Saccus epiploicus, 457; lacrymal., 494.

Saliva, 7.

Sanguis, 36.

Scalæ: tympani, vestibuli, 514.

Scapha, 506.

Scapula, 94.

Scissura longitudinal. cerebri, 615, 709.

Sclerotica, 497.

Scrobiculus cordis, 696.

Scrotum, 476.

Scyphus, 514.

Sebum cutan., 39.

Sella equina s. turcica, 48, 57.

Semicanalis tensor. tymp., 509.

Septum atriorum, 527; cordis, 527; crurale, 364; narium, 518; pellucidum, 619; penis, 482; scroti, 476; ventriculorum, 528.

Serum, 33, 35, 36.

Sinus, 489; basilaris, 625; cavernosus, 624, 625; circularis iridis, 497; Ridleyi, 625; duræ matris, 625; ethmoidales, 49; frontales, 50; jugulis, 61; lateralis, 625; longitudinales, 624, 625; mastoidei, 52; maxillaris,

- 59; occipitales, 624, 625; ophthalmicus, 625; perpendicular., 625; petrosi, 625; pterygoideus, 48; quartus s. rectus, 625; sphenoidales, 48; tarsi, 106; transversus, 624, 625; ven. portæ, 445; venos. retinæ, 501; vesicalis, 472.
- Situs viscerum, 708.
- Smegma præputii, 482.
- Socii, 145.
- Spatium intercostale, 694.
- Speculum Helmontii, 266.
- Spinæ: angularis, 48; basilaris, 47; ilii, 90; ischii, 91; mentales, 66; nasales, 50, 59, 60; occipitalis, 47; pharyngea, 47; pubis, 92; scapulæ, 94; tibiæ, 103; trochlearis, 50; tubercul. maj. et minor., 96; vertebrarum, 74.
- Splanchnologia, 426.
- Splen s. lien.
- Splenium corpor. callos., 619.
- Stapes, 510.
- Sternum, 84.
- Striæ: alba, 196; corneæ, 620; longitudinal., 619; transvers. Willis., 619.
- Subiculum cornu Ammon., 620.
- Substantia alba, 609, 613; cinerea, 609; ossea, 431; ferruginea, 623; perforata, 615, 618; spongiosa, 41; vitrea, 431.
- Sulci: arteriosi, 50, 51; caroticus, 48, 57; circular. cord., 527.
- Sulcus bicipit., 96; costalis, 85; lacrymalis, 59; lateralis, 51; longitudinalis cord., 527; cranii, 51, 57; humeri, 96; infraorbital., 68; mentolabialis, 428; mylo-hyoid., 66; nasolabialis s. linea; pro n. olfactorio, 49; oss. cuboid., 106; palatinus, 60; pterygoid., 48; pterygo-palatinus, 59; transversus cordis, 527; cranii, 47, 51, 52; tympani, 508.
- Supercilia, 491; acetabuli, 92.
- Superficies auricularis: lunata acetab. s. facies; -peronea, 103; tibialis, 104.
- Supinatore s. musculi.
- Sura s. musculi cruris.
- Sustentaculum tali, 106.
- Suturæ, 45; cranii, 54; palatinæ, 59, 60; transversæ, 60.
- Symphysis oss. pubis, 92; sacro-iliaca, 92.
- Synarthrosis, 45.
- Synchondrosis, 45.
- Syndesmologia, 110.
- Synovia, 29.
- Systema nervosum, 606.
- T.
- Tabula vitrea s. lamina, 57.
- Tænia, 620; coli, 443; semicircularis, 619.
- Talus, 106.
- Tapetum, 499.
- Tarsus, 106; palpebrar., 492.
- Tegumentum commune, 38.
- Tela elastica, 31.
- Tendines, 146; Achillis, 374; extensor cruris, 355.
- Tentorium cerebelli, 624.
- Testes, 477; cerebri, 619; muliebres, 483.
- Testiculi, 477.
- Thalamus opticus, 620.
- Theca, 484.
- Thenar, 321 bis.
- Thorax, 83.
- Tibia, 103.
- Tonsilla, 428, 621.
- Tonus, 143.
- Torcular Herophili, 625.
- Trabeculæ carneæ, 528; cavernos., 482.
- Trabes cerebri seu corp. callos., 619.
- Trachea, 466.
- Tractus foraminulentus, 514; intestinalis s. ductus; olfactorius, 630; opticus, 618, 631.
- Tragi, 506.
- Tragus, 506.
- Trigonum cervicale infer., 693; super., 692.
- Tripus Halleri, 572.
- Trochanter major and minor, 102.
- Trochleæ, 147, 335; femor., 102.
- Trochoides, 45.
- Truncus anonymus, 540; basilaris, 555; lymphaticus, 602; thyreo-cervicalis, 556.
- Tuba Eustachii, 511; Fallopiæ, 485.
- Tuber calcanei s. calx; cinereum, 618; cochleæ, 509; frontale, 50; ischii, 91; maxillare, 59; oss. ilii, 90; naviculare, 106; parietale, 51; valvulæ, 622.
- Tubercula: articularæ, 52; candatum, 445; fibulæ, 104; Loweri, 528; papillare, 445.
- Tuberositas condyli fem., 102; metatarsi V., 107; radii, 98.
- Tubuli Belliniani, 470; seminiferi, 477; uriniferi, 470.
- Tunicæ: adnata oculi s. conjunctiva

bulbi; testis, 477; albuginea lienis (which see); oculi s. sclerotica, ovarii, penis, renis, testis (see these); dartos, 476; erythroides s. m. cremaster; Jacobi, 501; nervea s. propria, 29; vaginalis commun. testis et funic. sperm., 478; propria funiculi, 478; propria testis, 477; vasorum, 523; vasculosa, 29.

Tutamina oculi, 491.

Tympanum, 509.

U.

Ulna, 97.

Umbilicus s. annul. umbilic., 261.

Umbo, 508.

Uncus, 623.

Ungues, 21.

Urachus, 453, 472.

Urea, 11.

Ureter, 471.

Urethra, 473.

Uterus, 486.

Utriculus ventricular., 515.

Uvea, 500.

Uvula, 428.

V.

Vagina, 487; cruris, 379; cubiti, 319; mucosæ, 148; muscutor., 146; muscul. recti abdom., 269; nervorum, 608; synoviales, 148; tendinum, 146; vasor. crural. and canal. crural., 362, 365.

Vallecula, 52, 616, 622.

Valvulæ: Bauhini, 438; cerebelli, 622; conniventes Kerkring., 438; Eustachii, 528; Fallopiæ s. Bauhini.; foram. oval., 528; ileo-cæcalis, 442; mitralis, 528; pylori, 436; semilunares s. sigmoideæ, 528; tricuspidalis s. triglochines, 528; Thebesii, 528; Tulpii, 440; vasor. lymphatic., 526; venarum, 525.

Vas deferens, 478.

Vasa: absorbentia s. resorbentia; aërofera, 467; bronchialia, 467; capillaria, 523; chyliifera s. lact.; efferentia and inferentia, 526; exhalantia, 523; lactea, 604; lymphatica, 526, 601; pulmonalia, 467, 534; resorbentia, 601; sanguifera, 521; vasorum, 522; vorticosa, 499.

Vasculum aberrans Halleri, 477.

Velum medullare, 622 bis; palatinum, 428.

Venæ, 525.

A. alares, 592; angularis, 592; anonymæ, 591; arteriosæ, 536; auriculares, 592; axillaris, 594; azygos, 595.

B. basilica, 594; brachiales, 594; breves, 598.

C. cardiacæ, 589; cava inferior, 596; superior, 590; cephalica externa, 592; interna, 592; pollicis radialis, 594; coronariæ cordis, 589; cruralis, 597.

D. dorsalis penis, 597.

F. facialis anterior, 592; posterior, 592; profunda, 592; frontalis, 592.

G. Galeni, 589.

H. hæmorrhoidalis, 597; hemiazygos, 595; hepaticæ, 596; hypogastrica, 597.

I. iliaca communis, 597; externa, 597; jugularis externa anter., 593; poster., 593; interna, 592.

L. labiales, 592; lienis, 598; lingualis, 593; lumbalis ascend., 595.

M. magna cordis, 589; Galeni s. brain, mammaria, 591; mastoideæ, 592; maxillaris interna, 592; mediana, 594; mesentericæ, 598; minores cordis, 589.

O. occipital., 592; ophthalmic., 592; ovaricæ, 596.

P. palatina, 592; parotideæ, 592; portarum, 598; pudenda, 596; pulmonales, 536.

R. ranina, 593; renales, 595.

S. salivarella, 594; saphenæ, 597; spermaticæ, 596; spinales, 600; splenica, 598; subclavia, 594; subscapular, 594.

T. temporales, 592; thyreoideæ, 591, 592; testiculares, 596; transversa colli and scapulæ, 593.

U. umbilicalis, 599.

V. vertebralis, 591; vesicales, 597; vorticosa, 592.

Ventriculus, 436.

Ventriculi: cordis, 527; laterales, 620; Morgagni, 464; quartus, 620; septi pellucidi, 623; tertius, 620.

Vermis, 622.

Vertebra, 75.

Veru montanum, 473.

Vesica fellea, 447; urinaria, 472.

Vesiculæ: germinativa, 483, 484; Graafian., 484; pulmonales, 467; seminales, 479.

Vestibulum, 512; vaginæ, 488.
Vibrissæ, 518.
Villi, 438.
Virga, 482.
Viscera, 426.
Vomer, 65.
Vulva, 488.

Z.

Zona ciliaris, 504; iridis, 500; Val-
salvæ, 514, 515.
Zonula Zinnii, 504; ossea lam. spiral.,
514.

THE END.

